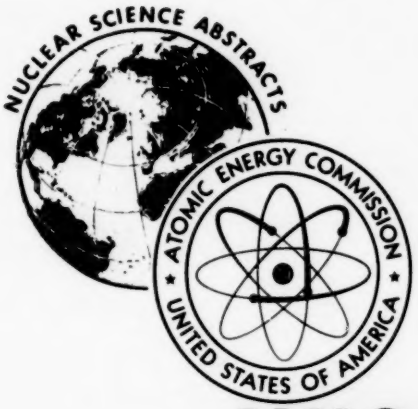
Y 3. At7 : 16/18 -12



NUCLEAR SCIENCE ABSTRACTS

JUL 1 4 1964

Volume 18 Number 12

Abstracts 19504–21741

MIAMI UNIVERSITY LIBRARY

June 30, 1964

UNITED STATES ATOMIC ENERGY COMMISSION
Division of Technical Information

USAEC DEPOSITORY LIBRARIES

Collections of USAEC reports are maintained in the libraries of the organizations listed below for reference use by the general public. Facilities for making photocopies are available. The USAEC also makes available through these libraries atomic energy reports of countries other than the U. S. that are abstracted in *Nuclear Science Abstracts*.

ALABAMA
- Auburn, Auburn University
- Birmingham, Public Library

ARIZONA
- Tucson, University of Arizona

ARKANSAS
- Fayetteville, University of Arkansas

CALIFORNIA
- Berkeley, University of California
- Davis, University of California
- Los Angeles, University of California
- Menlo Park, Stanford Research Institute
- San Diego, Public Library

COLORADO
- Boulder, University of Colorado
- Denver, Public Library

CONNECTICUT
- New Haven, Yale University

DELAWARE
- Newark, University of Delaware

DISTRICT OF COLUMBIA
- Washington, Library of Congress

FLORIDA
- Coral Gables, University of Miami
- Gainesville, University of Florida

GEORGIA
- Atlanta, Georgia Institute of Technology

HAWAII
- Honolulu, University of Hawaii

ILLINOIS
- Chicago, John Crerar Library
- Chicago, University of Chicago
- Evanston, Northwestern University
- Urbana, University of Illinois

INDIANA
- Indianapolis, Public Library
- Lafayette, Purdue University

IOWA
- Ames, Iowa State University

KANSAS
- Manhattan, Kansas State University

KENTUCKY
- Lexington, University of Kentucky
- Louisville, University of Louisville

LOUISIANA
- Baton Rouge, Louisiana State University
- New Orleans, Tulane University

MARYLAND
- Baltimore, Johns Hopkins University
- College Park, University of Maryland

MASSACHUSETTS
- Cambridge, Harvard University
- Cambridge, Massachusetts Institute of Technology

MICHIGAN
- Ann Arbor, University of Michigan
- Detroit, Public Library
- East Lansing, Michigan State University

MINNESOTA
- Minneapolis, University of Minnesota

MISSOURI
- Kansas City, Linda Hall Library
- Rolla, University of Missouri School of Mines and Metallurgy
- St. Louis, Washington University

MONTANA
- Bozeman, Montana State College

NEVADA
- Las Vegas, Nevada Southern University
- Reno, University of Nevada

NEW JERSEY
- Princeton, Princeton University
- Teaneck, Fairleigh Dickinson University

NEW MEXICO
- Albuquerque, University of New Mexico

NEW YORK
- Albany, The University of the State of New York
- Buffalo, State University of New York at Buffalo
- Ithaca, Cornell University
- New York, Atomic Industrial Forum, Inc.
- New York, Columbia University
- New York, New York University
- Rochester, University of Rochester
- Schenectady, Union College
- Syracuse, Syracuse University
- Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
- Charlotte, Public Library of Charlotte and Mecklenburg County
- Durham, Duke University
- Raleigh, North Carolina State College

NORTH DAKOTA
- Grand Forks, University of North Dakota

OHIO
- Cincinnati, University of Cincinnati
- Cleveland, Public Library

OHIO (CONT.)
- Columbus, Ohio State University
- Toledo, University of Toledo
- Youngstown, Youngstown University

OKLAHOMA
- Norman, University of Oklahoma
- Stillwater, Oklahoma State University

OREGON
- Corvallis, Oregon State University
- Portland, Reed College

PENNSYLVANIA
- Philadelphia, University of Pennsylvania
- Pittsburgh, Carnegie Library
- University Park, Pennsylvania State University

PUERTO RICO
- Rio Piedras, University of Puerto Rico

RHODE ISLAND
- Providence, Brown University

SOUTH CAROLINA
- Columbia, University of South Carolina

TENNESSEE
- Knoxville, University of Tennesse
- Memphis, Public Library
- Nashville, Joint University Libraries
- Oak Ridge, Oak Ridge Institute of Nuclear Studies

TEXAS
- Austin, University of Texas
- College Station, Texas A & M University
- Dallas, Southern Methodist University
- Houston, Rice University
- Lubbock, Texas Technological College
- San Antonio, Public Library

UTAH
- Salt Lake City, University of Utah

VIRGINIA
- Blacksburg, Virginia Polytechnic Institute
- Charlottesville, University of Virginia
- Norfolk, Old Dominion College

WASHINGTON
- Pullman, Washington State University
- Seattle, University of Washington

WEST VIRGINIA
- Morgantown, West Virginia University

WISCONSIN
- Madison, University of Wisconsin
- Milwaukee, Public Library

WYOMING
- Laramie, University of Wyoming

NOTICE

Title pages for Volume 18, Numbers 1–6 and 7–12, and an introduction to all of Volume 18 are included at the back of this issue for use in binding the first twelve issues as two units.

CORRECTIONS

NSA Vol. 18, No. 4, p. 880, abstract 6555; corporate author should be: Belgium. Commissariat à l'Énergie Atomique, Brussels.

Volume 18, Number 12, June 30, 1964

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director.
Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

Nuclear Science Abstracts covers the international literature on nuclear science and technology and provides the only comprehensive abstracting and indexing of this body of information. Published twice each month since 1947, *NSA* covers technical reports of the U. S. Atomic Energy Commission and its contractors, technical reports of U. S. Government agencies and other governments, universities, industrial and research organizations, as well as patents, books, and journal literature on a world-wide basis. More than 250,000 abstracts have appeared in *NSA* through Volume 17. The subject matter covered in *NSA* is described in detail in Report TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Abstracts are arranged according to a number of subject categories and subcategories. Definitions of categories appear in Issues No. 1 and 13. If the language of the original item is not English, the language will be indicated. Translations are not abstracted where an abstract of the original item has appeared in *NSA*.

INDEXES TO NSA

Subject, personal author, corporate author, and report number indexes appear in each issue and are cumulated quarterly, semiannually, and annually. The cumulative report number index annually cumulates all report numbers in all volumes.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

The public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations taken from *Dissertation Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan.

Most of the published literature abstracted in *NSA* is on deposit at the Oak Ridge Institute of Nuclear Studies Library, Oak Ridge, Tennessee, (a USAEC depository library) and is available through interlibrary loan. When requesting papers from this source, it is important that *NSA* volume and abstract number be cited.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

NSA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Government agencies may obtain *NSA* free of charge.

NSA is available to the general public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., as follows:

For the 24 regular issues, $30.00 domestic, $37.00 foreign. A single issue costs $1.75, plus 25 per cent for foreign mailing. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, British and French Guiana, Surinam, and British Honduras. Foreign rates apply to the countries excepted above and to all other countries throughout the world.

For the quarterly, semiannual, and annual indexes, $22.00 domestic, $25.00 foreign.

Multivolume subject and author indexes are available as follows:

Vols. 1–4 (1948–1950) Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003, $30.00.

Vols. 5–10 (1951–1956) Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $5.25.

Vols. 11–15, Subjects, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $19.00.

Vols. 11–15, Personal Authors, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $14.25.

Vols. 11–15, Corporate Authors, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $2.50.

Annual Indexes are available separately from the U. S. Government Printing Office as follows:

Vol. 16, Subject and Authors, $9.75.

Vol. 17, Subject and Authors, $12.25.

Cumulative Report Number, $5.25.

ACKNOWLEDGMENTS

Agreements between the United States Atomic Energy Commission and the following organizations with regard to providing continuing services and specific literature coverage for *Nuclear Science Abstracts* are gratefully acknowledged:

American Institute of Physics; Atomic Energy of Canada Limited; Atomic Energy Research Establishment, United Kingdom; European Atomic Energy Community (EURATOM); Gmelin Institute; International Atomic Energy Agency; Japan Atomic Energy Bureau—Japan Atomic Energy Research Institute; Netherlands Patent Office; Reactor Centrum Nederland.

TABLE OF CONTENTS

Volume 18, Number 12, June 30, 1964

Category	*Page*
BIOLOGY AND MEDICINE	2621
General	2621
Ecology	2622
Metabolism, Tissue Distribution, and Toxicology	2623
Radiation Effects	2628
Radiation Effects Therapy and Countermeasures	2663
Radiation Hazards and Protection	2671
Radiotherapy and Radiodiagnosis	2671
CHEMISTRY	2675
General	2675
Analytical Procedures	2675
Inorganic and Physical Chemistry	2685
Organic Chemistry	2699
Radiation Chemistry and Radiochemistry	2702
Separation Processes and Procedures	2711
ENGINEERING	2715
General	2715
Applications of Nuclear Explosions	2715
Facilities and Equipment	2716
Heat Transfer and Fluid Flow	2721
Materials Testing	2725
Protective Structures	2725
Vacuum Engineering	2725
GEOLOGY AND MINERALOGY	2726
General	2726
Natural Radioactivity and Fallout	2727
Techniques and Equipment	2729
Thorium and Uranium Minerals	2729
HEALTH AND SAFETY	2731
INSTRUMENTATION	2739
General	2739
Radiation Detection	2744
ISOTOPE TECHNOLOGY	2755
Industrial Applications	2755
Power Application	2756
Separation and Production	2756
MATHEMATICS AND COMPUTERS	2758
METALS, CERAMICS, AND OTHER MATERIALS	2759
General	2759
Corrosion	2762
Fabrication	2764
Properties and Structure	2769
Radiation Effects	2779
METEOROLOGY	2785
PHYSICS	2786
General	2786
Accelerators	2794
Astrophysics and Cosmology	2797
Atomic Physics	2798
Cosmic Radiation	2810
Direct Energy Conversion	2811
Elementary Particles and Radiations	2820
Field Theory and Quantum Mechanics	2834
Geophysics	2840
Low Temperature Physics	2843
Neutron Physics	2846
Nuclear Properties and Reactions	2851
Plasma Physics and Thermonuclear Processes	2878
Shielding	2902
REACTOR TECHNOLOGY	2903
General	2903
Auxiliaries and Components	2904
Criticality Studies	2908
Design and Feasibility	2911
Power and Power-Breeder Reactors	2914
Process Heat Reactors	2918
Propulsion and Space	2918
Research and Test Reactors	2921
WASTE DISPOSAL AND PROCESSING	2923
GENERAL AND MISCELLANEOUS	2925
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-11
SUBJECT INDEX	INDEX-56
REPORT NUMBER INDEX	INDEX-150

Managing Editor

John W. Norris

Assistant Managing Editor

Donald D. Davis

Associate Editor

Robert C. Kelly

Production Editor

Lawrence T. Whitehead

Technical Editor

David E. Bost

Subject Index Editor

Everett J. Hoffman

Evaluators

William D. Matheny
John H. Mitchell
Mary H. Newman
Lee M. Thompson

Subject Authority Editor

Thomas R. Henley

Corporate Authority Editor

Clara L. Fox

Abstractors

D. Lamar Cason
James R. Dulaney
Helen M. Gant
Bernard O. Griggs
Mary Catherine Grissom
Miriam P. Guthrie
Phyllis Hansen
Thomas F. Heagerty
Carolyn D. Houston
Rose V. Jermain
Julia Redford
Ned W. Rizzardi
Lila B. Smith
Charles E. Stuber
Martha J. Thomas
Robert E. Upchurch
Anne G. Ward
David C. West

Exchanges

Margaret L. Pflueger

Report Code Authority

Hannah B. Mayfield

Report Number Index Editor

Bobbie J. Dunlap

Scheduling and Publishing Coordinator

Henry H. Lansford

Communication concerning the editorial policy and content of *NSA* should be addressed to the Managing Editor, *Nuclear Science Abstracts*, AEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

Volume 18, Number 12 June 30, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

19504 (BNL-7839) ENIGMAS UNDERLYING THE STUDY OF HEMOPOIETIC CELL PROLIFERATION. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 53p. (CONF-330-3)

From the Proceedings of the Van Slyke Symposium, Upton, N. Y., Mar. 1963.

Present information is reviewed on steady state proliferation, differentiation, and maturation of blood cells in mammals. Data are cited from metabolic tracer studies, autoradiographic studies, cytologic studies, studies of hematopoietic response to radiation injuries, and computer analyses of blood cell production. A 3-step model for erythropoiesis and a model for granulocyte kinetics are presented. New approaches to the study of lymphocytopoiesis described include extracorporeal blood irradiation to deplete lymphocytic tissue without direct injury to the formative tissues as a means to study the stressed system, function control, and rates of proliferation. It is pointed out that present knowledge indicates that lymphocytes comprise a mixed family, with diverse life spans, functions, and migration patterns with apparent aimless recycling from modes to lymph to blood to nodes that has not yet been quantitated. Areas of future research are postulated. (70 references.) (C.H.)

19505 (BNL-7912) SOMATIC MUTATIONS AND CARCINOGENESIS. Howard J. Curtis (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 19p. (CONF-472-1).

From the American Cancer Society Conference, Rye, N. Y., May 1964.

Evidence indicating that mutations play a dominant role in the aging process is reviewed. It is pointed out that carcinogenesis is one facet of the aging process, so mutations must play a major role here also. However, carcinogenesis certainly does not consist of the simple induction of a mutation in one cell which confers the property of uncontrolled growth on that cell and its progeny. There must be some general conditions created, as well as a specific event, before carcinogenesis can take place. It is postulated that mutations in one form or another are responsible for both conditions. (auth)

19506 (TID-20401) POPULATION DYNAMICS IN THE EVOLUTION OF MUTANT GENES. Final Report, December 1, 1960–November 30, 1963. Ken-ichi Kojima (North Carolina State Coll., Raleigh). Jan. 1964. Contract AT(40-1)-2798. 17p.

Progress is reported in investigations of the evolutionary process of mutant genes through which mutations contribute to the genetic variability of populations. Emphasis was placed on the early stage of mutant evolution immediately after the occurrence of mutations and the late stage where the number of mutation-bearing individuals increased considerably. Data are presented from studies on populations of Drosophila and Habrobracon. (C.H.)

19507 (TID-20402) GAMETOPHYTE-DEPENDENT VARIATION IN EXPRESSION OF $\underline{R}^r$ MAIZE GENES. Jerry L. Kermicle (Wisconsin. Univ., Madison). [196?]. Contract AT(11-1)-1300. 21p.

Results are reported from studies on genetic factors that control R-mottling, or the irregular distribution of anthocyanin pigmentation, in the aleurone layer of maize endosperm. The predominant influence determining mottling rather than solid color expression was found to be related to the transmittal of $\underline{R}$ via pollen or embryo sac. (C.H.)

19508 (JPRS-23956) SOVIET STUDIES IN VIROLOGY. Translated from Vopr. Virusol., 9: No. 1, 19-24; 66-72; 83-90(1964). 27p. (OTS-64-21950).

Three papers are presented: separate abstracts were prepared for two. (H.M.G.)

For abstracts of individual papers see: 19556 and 19557.

19509 A COMPARISON OF TWO MARKERS OF CELL PROLIFERATION IN BONE MARROW. P. K. Lala, M. A. Maloney, and H. M. Patt (Argonne National Lab., Ill.). Acta Haematol., 31: 1-8(Jan. 1964).

Mitotic indices were determined for different cell types in myeloid and erythroid populations of canine and human marrow. Dividing cells in all phases were scored in orcein-stained marrow preparations. Specific mitotic indices were obtained from the total mitotic index of the orcein preparation and the differential cell and mitotic counts of marrow smears stained by Wright's method. Proliferation rates of myeloid and erythroid cells based on mitotic activity were related to rates determined from labeling with tritiated thymidine. There was reasonably good agreement between these two markers of cell proliferation, viz., mitosis and DNA synthesis. (auth)

19510 QUANTITATIVE CELL COUNTS OF THE BONE MARROW AND BLOOD AND THEIR SECULAR VARIATIONS IN THE NORMAL ADULT RAT. E. V. Hulse (Medical Research Council, Harwell, Berks, Eng.). Acta Haematol., 31: 50-63(Jan. 1964).

A method for obtaining the absolute number of each type of marrow cell in experimental animals is described in

detail. Absolute cell counts are given for the bone marrow and blood of two separate series of rats, one of 40 and the other of 41 animals. Some of the secular variations in cell counts coincided with a change in animal husbandry which might have entailed changes in the genetic constitution of the strain. These changes emphasize the need for frequent observations on control animals during hematological experiments. The femur, tibia, and humerus contained similar numbers of nucleated cells but the marrow of the humerus contained fewer non-nucleated red cells. The cell content of marrow of a bone on one side was the same as that in the same bone on the opposite side. Exsanguination did not reduce the amount of blood contaminating samples of bone marrow. (auth)

19511 ENHANCED SURVIVAL OF SKIN HOMOGRAFTS IN MICE WITH A BACTERIAL INFECTION. I. A. Iossifides, L. Gutzait, M. Brand, and L. M. Tocantins (Jefferson Medical Coll., Philadelphia). Ann. N. Y. Acad. Sci., 114: 487-95(Mar. 31, 1964).

During an unrelated experiment, A-strain mice injected with 0.5×10^9 C_3H/He splenic cells were given skin homografts from the original spleen donor. In 4 of the 14 grafted animals prolongation of the homograft survival coincides with the presence of a large, chronic, intraperitoneal abscess caused by a Corynebacterium species. The observation suggested the possibility of a relation between bacterial infection and the homograft survival. In attempts to investigate this possibility A mice were inoculated intraperitoneally with the same organism. In only 9 of 67 infected animals a large abscess was formed; these nine mice showed an average of five days' increase in the mean homograft survival-time. Splenectomies did not alter the results. The number of experiments is small for statistical analysis but an indication is offered that within the animal an interdependency and a mutual influence may exist between immunologic reactions against bacterial and against tissue antigens. (auth)

19512 ON CHANCE AND CHOICE. David Hawkins (Univ. of Colorado, Boulder). Rev. Mod. Phys., 36: 512-17(Apr. 1964).

The theory of a taxonomic game is used to establish the informational model of probability. The theory of priorities is presented. Taxonomic games–strategies, redundancy, and power–are discussed. These ideas are applied to copying processes in biology, in particular, DNA reproduction in mitosis. (M.J.T.)

19513 GENETIC STUDIES ON THE BEHAVIOR OF THE B^3 CHROMOSOME IN TB-3a, AND THE USE OF A-B TRANSLOCATIONS IN MUTATION STUDIES, IN MAIZE. Ikuko Fukuda Mizukami. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 87p.

An A-B translocation, designated as TB-3a, was used to study the behavior of the B^3 chromosome. Through a detailed genetic study of progenies produced by the cross $3\ 3 \times 3\ 3^B\ B^3\ B^3$ (pollen parent), the nondisjunction of B^3 chromosomes during microsporogenesis and at the 2nd mitotic division in microspore was confirmed. However, nondisjunction of the B^3 chromosomes at the 2nd microspore division was found only $3^B\ B^3$ pollen, not in $3\ B^3$ pollen. Rates of nondisjunction of the B^3 chromosomes in $3^B\ B^3$ pollen were similar in the three families analyzed but rates of preferential fertilization varied greatly in the different families. When $3\ 3^B\ B^3\ B^3$ plants were used as egg parents, nondisjunction of the B^3 chromosomes at meiosis was apparent. There was no indication of nondisjunction during embryo sac formation. The advantages expected from the use of A-B translocations in the study of mutations as compared with conventional methods are discussed. To test the expected advantages, TB-1a, TB-3a, TB-9a, TB-9b, and TB-10a were chosen as pollen parents. As egg parents, Hy2/Oh7, multiple-dominant single-cross hybrids, McClintock's Ds;ac/ac and Ds;Ac/ac, bz-s and bz-m, and wx-s and wx-m were used. The first two kinds of egg parents were studied with and without x-ray treatment. The use of mutable strains was based on the expectation that mutation would be enhanced by the transposition of mutable elements. The total number of kernels analyzed was approximately 648,000. The most frequent phenotypes expressed as seedling and endosperm mutants were yellow-green and abnormal morphology, and defective kernels, and endosperm marking, respectively. Relatively few cases of prospective mutants transmitted their mutant phenotypes to the following generations, and only rarely were the mutant phenotypes fixed in homozygous condition after one or two generations of self-pollination. In general no qualitative differences were observed in seedling and endosperm mutants among the different pollen parents, egg parents, or egg parent treatments. The results indicate that the use of A-B translocations in mutation study does not appear to be promising. The technical difficulties encountered in the experiments are also discussed. (Dissertation Abstr., 24: No. 9, March 1964)

19514 RADIOTRACER METHODOLOGY IN BIOLOGICAL SCIENCE. David Lee Willis. Thesis, Corvallis, Ore., Oregon State Univ., 1963. 627p.

The essential concepts and information needed by the biologist using radiotracer methods are summarized in an introductory text suitable for class or individual use. The 3 sections of the text are: the text proper, covering the principles of radiotracer methodology; a set of basic laboratory exercises, intended to familiarize the user with procedures in detecting and characterizing radioactivity; and a selection of typical radiotracer experiments illustrating applications in various fields of biological science. Particular attention is devoted to liquid scintillation counting. An extensive bibliography, covering both the preparation of samples for liquid scintillation counting and the operating characteristics of the counter assembly, is included. The safe handling of radioisotopes, the proper design of radiotracer laboratory facilities, and the statistical analysis of counting data are also treated. A chapter on the methods of primary radioisotope production and the preparation of labeled compounds is included as background information. The technique of tritium labeling by gas-exposure (the Wilzbach method) is also discussed. (Dissertation Abstr., 24: No. 8, Feb. 1964).

Ecology

19515 (NP-13796) PLANT UPTAKE OF RADIOELEMENTS FROM SOIL. William B. Lane, James D. Sartor, and Carl F. Miller (Stanford Research Inst., Menlo Park, Calif.). Mar. 1964. 213p.

A model is presented for predicting food crop contamination by root uptake of fission products from fallout. The model was tested with existing data to obtain equation constants which would permit a solution for a hypothetical contaminating event. Values for many crop-isotope combinations were estimated or assigned because of lack of data. The derived or estimated constants for important agricultural crops are summarized for computer input. Results of a nation-wide survey to obtain the exchangeable Ca content of the soil in each country of the United States are presented. The effects of various soil management practices on the ratios and amounts of radionuclides

that enter and stay in different parts of the plant are discussed. (C.H.)

19516 THE CONTENT OF ^{125}Sb IN SOIL COVER AND IN PLANTS. S. V. Iokhel'son and D. K. Popov. At. Energ. (USSR), 16: 155-9(Feb. 1964). (In Russian)

The most important long-lived fission products are $^{144}Ce-^{144}Pr$, ^{137}Cs, $^{90}Sr-^{90}Y$, $^{106}Ru-^{106}Rh$, ^{147}Pm, and ^{125}Sb. The relative yields of these fission products are listed for the fission of ^{235}U, ^{233}U, and ^{239}Pu by thermal and fast neutrons. Since ^{125}Sb is ordinarily not determined, samples of soil and plant ash were analyzed on a 100-channel γ spectrometer in 1959 and again in 1961. Due to the long time lapse of two years, it was determined that the 430 and 460 kev peaks belonged to ^{125}Sb, which has a half life of 2.7 years (the half life of the isotope had to be longer than that of ^{144}Ce or ^{106}Ru). The relative activity of ^{125}Sb was determined from the area of the photopeak, and was compared with the relative activities of $^{144}Ce-^{144}Pr$, $^{106}Ru-^{106}Rh$, and ^{137}Cs. The results were tabulated. The activity level of ^{125}Sb is comparable to the activity level of $^{106}Ru-^{106}Rh$ in the soil. (TTT)

19517 NATURAL RADIOACTIVITY OF ORGANISMS. I. RADIOACTIVITY OF CERTAIN VERTEBRATES. Zh. Lambrev and N. Balabanov (Higher Inst. of Nature and Mathematics, Plovdiv, Bulgaria). Radiobiologiya, 3: 875-6(1963). (In Russian)

Investigations of natural radioactivity of five different species showed the following natural radioactivity order: carp, rats, frogs, sparrows (Passer), and turtles. A certain correlation was found between the natural radioactivity of the animal and of the environment. (R.V.J.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 20346.

19518 (BNL-7007) INCORPORATION OF ^{3}H-ARGININE IN CHROMOSOMES OF VICIA FABA. Wolf Prensky and Harold H. Smith (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT(30-2)-Gen-16. 13p.

Tritiated arginine was used in an effort to label the nuclear protein of Vicia faba root meristem cells. Previous to labeling, the root tips were treated for 24 hr with 5-aminouracil in order to synchronize cell divisions and obtain a large proportion of mitotic figures. Autoradiographs of chromosomes from the first and second division after labeling were examined. Almost 100% of the chromosomes in the first division were labeled. The marked absence of label in metaphase chromosomes at second division suggests turnover of a major fraction of nuclear protein during one DNA replication cycle. (auth)

19519 (IS-655) ISOTOPIC COMPOSITION OF VANADIUM FROM ORGANIC SOURCES. I. CIONA INTESTINALIS AND ASCIDIA CERATODES. Jennings Capellen, Gerald D. Flesch, and Harry J. Svec (Ames Lab., Ames, Iowa). [May 10, 1963]. Contract [W-7405-eng-82]. 7p.

The $^{50}V/^{51}V$ ratios of vanadium from the ascidians, Ciona intestinalis and Ascidia ceratodes, were measured, on an absolute basis, by comparison with a reference using a CEC Model 21-220 180° mass spectrometer. The isotopic ratio of the vanadium from both the reference and the Ciona was 0.00250 ± 1, while that from the Ascidia was 0.00259 ± 3. (auth)

19520 (TID-20499) UPTAKE OF RADIONUCLIDES BY MICROORGANISMS. EMPHASIS UPON THE MECHANISM OF UPTAKE OF CALCIUM IN MARINE BACTERIA COMPARED WITH THE MOLLUSC, STROMBUS GIGAS. Final Report, April 15, 1963 to December 14, 1963. Leonard J. Greenfield (Miami, Fla. Univ. Marine Lab.). Jan. 8, 1964. Contract AT(40-1)-2855. 61p.

The source of carbonate in marine molluscan shell formation was investigated in the immature queen conch, Strombus gigas, using $Na^{14}CO_3$ as a source of inorganic carbonate and ^{14}C-L-alanine, L-serine, and L-glutamic acid as organic sources. The uptake of the labeled compounds, and of ^{45}Ca as $CaCl_2$, was determined as related to the physical activity of the animal. Results indicate that the conch can utilize many substances dissolved in the sea water environment as a source of carbonate and that the site of absorption is not limited to the gut wall. The role of marine bacteria in biological calcification in the sea was also investigated. Results are reported from studies of surface binding of Ca and Mg by the cell envelope of Pseudomonas piscicida, a bacteria found in shallow water marine sediments. Calcium-45 and ^{14}C-alanine were used as tracers. It was concluded that at least two mechanisms are directly involved in the uptake of Ca and Mg by P. piscicida from sea water and that as the cells age increased amounts of $CaCO_3$ are deposited but $MgCO_3$ deposition remains relatively static. (C.H.)

19521 (USNRDL-TR-716) IONIC RELATIONSHIPS OF THE BIOELECTROGENIC MECHANISM IN ISOLATED RAT STOMACH. J. T. Cummins and B. E. Vaughan (Naval Radiological Defense Lab., San Francisco). Feb. 10, 1964. 38p. (AD-433804)

The potential as measured in vitro across rat stomach was examined by substitution, inhibition and flux studies. The effect of choline substitution for Na on the potential was shown to be immediate, and to act on the mucosal influx, changing it from 1.4 to 0.2 μeg of Na/hr. Anoxic condition affected mucosal outflux only. The transmembrane potential is linearly dependent on mucosal Na concentration to 55 mM, where the system apparently becomes saturated. Replacement of chloride by sulfate raises the potential. A K requirement could be demonstrated by the elimination of chloride, and a Ca deficiency was noted only in the presence of high concentrations of EDTA. Dinitrophenol was shown to be the most effective of a series of metabolic inhibitors. Gastric mucosa possesses an ATPase, stimulated by Na and K and inhibited by ouabain. All these results point to the conclusion that the potential difference across isolated rat stomach is generated by a sodium transport mechanism, as characterized by others in different tissues. (auth)

19522 KRYPTON^{85} AND NITROUS OXIDE UPTAKE OF THE HUMAN BRAIN DURING ANESTHESIA. S. C. Alexander, H. Wollman, P. J. Cohen, P. E. Chase, E. Melman, and M. Behar (Univ. of Pennsylvania, Philadelphia). Anesthesiology, 25: 37-42(Jan.-Feb. 1964).

A method of calculating whole brain inert gas uptake during periods of stable cerebral blood flow (CBF) was developed and used to calculate brain ^{85}Kr uptake at three levels of CBF in 13 human subjects during halothane anesthesia at constant pulmonary ventilation. In addition, brain N_2O uptake was calculated in five humans during thiopental anesthesia at two levels of CBF. The rate of whole brain ^{85}Kr uptake was shown to vary in a hyperbolic manner with CBF, and alveolar ventilation was demonstrated to be an important determinant of the rate of brain inert gas uptake. At comparable levels of alveolar ventilation and CBF, the rate at which brain N_2O uptake proceeded did not differ markedly from the rate of brain ^{85}Kr saturation. Whole brain ^{85}Kr saturation lagged behind jugular venous satura-

tion at all times. Complete whole brain ^{85}Kr equilibration was never achieved even at high levels of CBF. Clinical implications of these findings are discussed. Since both brain blood flow and alveolar ventilation affect cerebral gas equilibration, an anesthetist may attempt to hasten brain gas uptake or elimination by increasing pulmonary ventilation. However, increased ventilation decreases arterial P_{CO_2} and hence cerebral blood flow is lowered, which could completely negate the desirable effects produced by increased pulmonary ventilation. However, hyperventilation can be used to produce a rapid alteration of brain inert gas concentrations if ~4% CO_2 is maintained in the inspired anesthetic mixture to prevent a reduction in arterial P_{CO_2} and a fall of CBF. Then, the production of pulmonary hyperventilation while preventing a reduction in CBF would permit a rapid, efficient change in brain inert gas content. (BBB)

19523 EFFECTS OF SELECTED CYTOTOXIC AGENTS ON ANTIBODY PRODUCTION IN MAN; A PRELIMINARY REPORT. George W. Santos, Albert H. Owens, Jr., and Lyle L. Sensenbrenner (Baltimore City Hospitals and Johns Hopkins Univ., Baltimore). Ann. N. Y. Acad. Sci., 114: 404-23(Mar. 31, 1964).

Experiments were performed to detect any effect of the chemical agents employed on antibody production in man. These agents are commonly classed as cytotoxic. Mechlorethamine, cyclophosphamide, 6-mercaptopurine, 5-fluorouracil, 5-fluoro-2′-deoxyuridine and methotrexate were chosen for study. Cyclophosphamide, 6-mercaptopurine, 5-fluorouracil, 5-fluoro-2′-deoxyuridine and methotrexate were found to eliminate or markedly impair the serologic response to a foreign antigen in humans with various neoplastic diseases. Mechlorethamine under the circumstances of these experiments did not interfere noticeably with the development of circulating antibodies against P. tularensis or Vi antigen. The patients who received mechlorethamine or no drug-treatment developed antibody titers in a fashion similar to that reported by Saslaw in normal men immunized with Pasteurella tularensis vaccine and by Landy in normal men given the Vi antigen. None of the chemical agents studied under the conditions of these experiments significantly altered existing red-blood-cell isoagglutinin titers or established (cutaneous) delayed hypersensitivity. In these experiments, no obvious relation between changes in the formed elements of the peripheral blood and suppression of immune responsiveness was detected. Inspection of the patient data in the various experimental categories with regard to their ages, medical diagnoses, extent of their diseases, survival times, serum albumin/globulin ratios, isoagglutinin titers and responsiveness to (delayed hypersensitivity) skin tests does not suggest that any of these variables, singly or in combination, could be related to the altered antibody responses which are attributed to the drugs. Conclusions concerning the comparative effectiveness of these agents in suppressing immune responses must await completion of quantitative dose-response and dose-schedule studies. Similarly, sound extrapolations from animal studies to man must be based on careful quantitative scrutiny of the several variables involved in each experimental system. (auth)

19524 INHIBITION OF DNA SYNTHESIS IN MURINE BONE-MARROW CELLS BY AET AND CYSTEAMINE. M. La Salle and D. Billen (Univ. of Texas M. D. Anderson Hospital and Tumor Inst., Houston). Ann. N. Y. Acad. Sci., 114: 622-9(Mar. 31, 1964).

Studies were designed to determine whether AET and cysteamine would alter DNA synthesis in mammalian hemic cells. In vivo studies were performed on young male Swiss mice injected with tritiated thymidine, and in vitro studies were made with bone marrow from either hybrid or Swiss mice. In the in vitro studies a one-hour exposure to tritiated thymidine was allowed. It was shown that AET administered to mice, at times and concentrations compatible with its use as a radioprotective agent both in vitro and in vivo leads to a marked inhibition of DNA synthesis. Cysteamine also inhibited bone-marrow DNA synthesis in vitro. (H.M.G.)

19525 A NEW TECHNIQUE FOR HIGH-RESOLUTION DENSITY-GRADIENT SEPARATION OF BONE-MARROW CELLS. Sadek K. Hilal, Donn G. Mosser, Merle K. Loken, and Robert W. Johnson (Univ. of Minnesota Hospitals, Minneapolis). Ann. N. Y. Acad. Sci., 114: 661-76(Mar. 31, 1964).

A new technique with minimal artifacts was developed for high-resolution density-gradient separation of viable cells. Differences as small as 0.002 in the density of the cells can be easily detected. It has been possible to detect differences of 0.0005 with careful manipulation. The development of this technique has necessitated the construction of a new centrifuge head, the preparation of a new suspension medium, and a new density gradient, and finally the development of a new centrifuge tube. Results on experiments on the bone marrow of three dogs are reported. (auth)

19526 FACTORS INFLUENCING THE POSTSTORAGE VIABILITY OF HUMAN BONE MARROW. Hugh M. Pyle and Hilda F. Boyer (Protein Foundation, Jamaica Plains, Mass.). Ann. N. Y. Acad. Sci., 114: 686-94(Mar. 31, 1964).

Techniques for preserving the viability of human bone marrow discussed are: the preservative compound, rate of freezing, biochemical factors, and the resuspension medium. (H.M.G.)

19527 TRANSPLANTATION POTENTIAL OF FRESH AND STORED HEMATOPOIETIC TISSUE AS ESTIMATED BY STANDARD IN-VITRO TECHNIQUES. J. P. Lewis, M. P. Farnes, M. Albala, F. E. Trobaugh, Jr. (Presbyterian-St. Luke's Hospital, Chicago and Univ. of Illinois, Chicago). Ann. N. Y. Acad. Sci., 114: 701-16(Mar. 31, 1964).

The ability of three in vitro systems to predict marrow-repopulating potential was tested and it was found that the data do not measure this potential. The results of dye-exclusion tests are greatly influenced by the suspension medium and the prior treatment of cells. They are widely used in estimating the viability of homogeneous suspensions of cells such as lymphocytes or tumor cells, but marrow is a suspension of heterogeneous cells. In tissue culture, it was noted that the sick-looking thawed cells return to a state of apparent good health and activity, but were not able to apply these observations to study of the repopulating unit. Early in short-term tissue culture the thawed cells appear damaged. It is anticipated that any in vitro test of viability applied shortly after thawing would be greatly affected by this apparent damage. Incorporation of labeled thymidine into DNA apparently reflects the number of cells in the phase of DNA synthesis, but there is no evidence that it reflects the number of viability of the cells responsible for repopulation. (auth)

19528 ON SECRETION OF I^{131} IN THE TRACHEAL SECRETION OF THYROIDECTOMIZED GUINEA PIGS AND ITS INFLUENCE BY DRUGS. O. Eichler, P. Finzer, M. Hoebel, and G. A. Krueger (Universität, Heidelberg).

Arch. Intern. Pharmacodyn., 268-79(Jan. 1, 1964). (In German)

Thyroidectomized guinea pigs, weighing 300 to 500 g, were given 200 μC $Na^{131}I$. The animals were sacrificed 1, 2, and 3 hr afterwards; and the ratios of tracheal secretion/plasma, tracheal mucosa/plasma, and secretion/trachea activity were determined. Secretion/trachea ratio in controls dropped from 5.25 (1 hr) to 2.08 (3 hr) (mean value of 7 to 9 animals). Animals given 200 mg/kg $NaClO_4$ in water 1 hr previously showed secretion/plasma activity of 0.698 and trachea/plasma activity of 0.699, not significantly different from the controls. In another series, pilocarpine (0.5 mg/kg) was given intraperitoneally 1 hr after the NaI, and the animals sacrificed 1,2,3, and 5 hr after administration of the drug. Pilocarpine increases the concentration of ^{131}I in the tracheal secretion significantly, particularly 3 hr after drug administration, when secretion/plasma ratio was 31.0; 2 hr later this was 12.5. After 2, 3, and 5 hr the secretion/trachea and trachea/plasma ratios did not differ significantly from the controls. The combined effect of the $NaClO_4$ and pilocarpine treatments was to return the result to those found with $NaClO_4$ alone; thus $NaClO_4$ decreases secretion of ^{131}I. Ten minutes' ether narcosis before sacrifice of the animals led to an increase of secretion/trachea ratio of 1.1-, 3.1-, and 2.3-fold over controls and of trachea/plasma of 1.2-, 1.5-, and 1.4-fold over controls for 1, 2, and 3 hr. Plasma activity studies also indicated a decrease in secretion caused by $NaClO_4$. Thus pilocaprine and ether treatment appear to increase secretion of ^{131}I. (BBB)

19529 THE DISTRIBUTION OF RADIOBISMUTH IN THE RAT. S. Eridani, M. Balzarini, D. Taglioretti, M. Romussi, and R. Valentini (Università, Milan and Clinic S. Ambrogio, Milan). Brit. J. Radiol., 37: 311-14 (Apr. 1964).

The physical characters of emission and decay of the isotope ^{206}Bi are discussed. Two different compounds of such an isotope were administered to rats and the uptake of the isotope in various organs and tissues was studied at different times after the administration. The possible implications of these results in relation to a clinical trial of these compounds is discussed. (auth)

19530 STUDIES OF BODY WATER AND WATER TURNOVER DETERMINED WITH DEUTERIUM OXIDE ADDED TO FOOD. O. H. Gaebler and H. C. Choitz (Henry Ford Hospital, Detroit). Clin. Chem., 10: 13-20(Jan. 1964).

The use of D_2O for investigation of water metabolism was explored in dogs. When the animals ingested 25 or 50 ml D_2O one daily meal, maximum plasma concentrations of D were reached in 12 to 24 hr. The disappearance rate during 14 days was exponential, confirming studies in humans. Water turnover, calculated from values obtained for body water and the disappearance rates, agreed well with total water intake, which included water taken as such and that derived by oxidation. Water intake per m^2 of surface area varied widely; there was also no constant relation between either total turnover or extrarenal loss and caloric intake. Since animals were maintained at nearly constant weights for long periods, caloric intake and total heat production were presumably equivalent. Thus the possibility of estimating total heat production from water turnover or extrarenal loss was not promising, but the validity of body water and turnover estimations was well supported. Average value for body water was 60.6% of body weight, with a range of 56.1% to 66.6%. The average value was similar to that of 61.8% previously reported for human males and above the 51.9% for human females. (BBB)

19531 EFFECT OF X-IRRADIATION ON ZINC-65 METABOLISM IN THE LIVER OF MICE. Kunio Matsui and Kei Yaeno (Osaka City Univ.). Intern. J. Radiation Biol., 7: 201-3(Aug. 1963).

Normal, x-irradiated, and diet control groups of mice were used to show that the characteristic change of ^{65}Zn metabolism occurs mainly in the soluble fraction of liver homogenate. The animals were given 0.3 μC of ^{65}Zn/g body-weight six days prior to sacrifice and subsequent to preparation of liver homogenates. It was found that, as compared with the normal group, the liver weights of the irradiated and diet control groups decreased without change in the proportion of soluble and particle fractions; the specific total contents of ^{65}Zn of both fractions of the irradiated group increased; limitation of food caused a proportional decrease in the ^{65}Zn content of both fractions; and ^{65}Zn concentrations of the livers were higher in the irradiated group. (H.M.G.)

19532 COMPARISON OF CONCENTRATIONS OF ALPHA-EMITTING ELEMENTS IN TEETH AND BONES. Vilma R. Hunt, Edward P. Radford, Jr., and Ascher J. Segall (Harvard Univ. Boston). Intern. J. Radiation Biol., 7: 277-87(Sept. 1963).

To evaluate the suitability of teeth as indicators of the skeletal burden of α-emitting elements, variability of content of ^{226}Ra, ^{210}Pb, and ^{228}Th was determined for different teeth from the same individual, and between tooth levels and the amount in bone samples from the iliac crest in the same individual. There was a significant correlation between the levels of ^{210}Pb and ^{226}Ra in teeth compared with iliac crest, supporting the conclusion that teeth are adequate samples to estimate human skeletal burdens of these α-emitting elements. Preliminary results are given indicating that local variations within individual bones or teeth may be considerable; thus any small sample of calcified tissue may be an inadequate indicator of total-body burden. Even so, teeth are as satisfactory as small bone fragments for comparing levels in groups of human subjects. (auth)

19533 THE INFLUENCE OF DIFFERENT DIETS ON RADIOSTRONTIUM RETENTION IN SKELETON OF MAMMALS. H. Kriegel, W. E. Kollmer, and E. Weber (Heiligenberg-Institut, Ger.). Intern. J. Radiation Biol., 7: 289-99(Sept. 1963). (In German)

The retention of radiostrontium by growing rats receiving different diets before and after a single injection of the isotope was compared with rats receiving a standard diet. A reduction of ^{90}Sr-content of the femur was induced by a Sr-enriched standard diet and a Ca-rich, P-deficient diet, fed either before or after injection of the isotope. Results are discussed in connection with the metabolism of bone and the therapy of radiostrontium intoxication. (auth)

19534 ENHANCEMENT OF THE EXCRETION OF RADIOCAESIUM IN RATS BY FERRIC CYANOFERRATE(II). V. Nigrovic (Nuclear Research Centre, Karlsruhe, Ger.). Intern. J. Radiation Biol., 7: 307-9(Sept. 1963).

Cesium-137 chloride and ferric cyanoferrate(II) were administered by gastric tubes to rats. Retention of ^{137}Cs was assayed by whole-body counting. Results show that ferric cyanoferrate(II) has a pronounced suppressing effect on enteral ^{137}Cs absorption. Therapeutic applicability of this finding is indicated. (H.M.G.)

19535 THE EFFECT OF LANTHANIDES AND ACTINIDES ON BLOOD COAGULATION. I. EVIDENCE FOR AND PROPERTIES OF A NEW SERUM THROMBOPLASTIC FACTOR. Robert Colman and Benjamin Alexander (Beth

Israel Hospital, Boston and Harvard Univ., Boston). J. Clin. Invest., 43: 705-19(Apr. 1964).

Thorotrast in vivo promptly induces retarded coagulation and in vitro a profound inability of both plasma and serum to support thromboplastin generation. The same abnormality is induced in serum by thorium chloride and the related elements, Nd, La, Ce, and U. The plasma defect consists of progressive inactivation of accelerator globulin (Factor V). The serum defect involves an entity distinct from any hitherto known clotting factor or intermediate. It is adsorbable by $BaSO_4$, elutable by citrate, and it is demonstrable in the protein fraction precipitated at 50 to 60% $(NH_4)_2SO_4$. The vulnerable factor in serum (TVF) is relatively labile, was separated from the other coagulation factors by physicochemical means, and can be markedly activated by trypsin. Replacing Inosithin by normal platelets in the thromboplastin generation mixture corrects the Th-induced defect. In contrast, Th-treated platelets are inert. Citrate and oxalate completely reverse the Th-induced defect, but EDTA is ineffective. It is suggested that the lanthanides and actinides produce a defect in serum by forming a reversible complex with a serum protein, which is a hitherto unrecognized clotting factor necessary for thromboplastin generation. The mechanism by which the biologic function of this protein is comprised by this group of elements, structurally similar atomically, appears to be reversible chelation at specific sites on the protein essential for its clotting activity. (auth)

19536 THE EFFECT OF LANTHANIDES AND ACTINIDES ON BLOOD COAGULATION. II. ASSAY OF A NEW SERUM THROMBOPLASTIC FACTOR VULNERABLE TO THESE ELEMENTS AND ITS VARIATIONS IN HEALTH AND DISEASE. Robert Colman and Benjamin Alexander (Beth Israel Hospital, Boston and Harvard Univ., Boston). J. Clin. Invest., 43: 720-7(Apr. 1964).

An assay procedure for measuring the thorium (and related elements) vulnerable factor is described. The range of this clotting factor was defined in 14 normal subjects. Thorium vulnerable factor is markedly depressed in newborn infants. After ingestion of coumarin derivatives it declines at rates and attains levels that do not correlate with prothrombin, proconvertin, or Stuart Factor. In severe liver disease, levels of the thorium vulnerable factor are low, corresponding in degree to accelerator globulin. In contrast to proconvertin, plasma thromboplastic component, or Stuart Factor the factor is not elevated in the gravid. These findings provide additional evidence that the thorium vulnerable entity is a hiterto unrecognized serum factor necessary for thromboplastin generation. (auth)

19537 TRACER DYNAMICS AND THE DETERMINATION OF POOL-SIZES AND TURNOVER FACTORS IN METABOLIC SYSTEMS. Per-Erik E. Bergner (Karolinska Institutet, Stockholm). J. Theoret. Biol., 6: 137-58 (Mar. 1964).

Tracer dynamics constitutes a theory aimed to simplify a physicobiologically significant interpretation of tracer data, especially of such data as are accessible on the supply of radioactive isotopes to metabolic systems. A simplified survey of the theory is presented. An essential problem is to find out how and when the behavior of the small amount of radioactive isotopes supplied to the system as tracer is representative of the properties of the isotopes naturally present in the system. An attempt at a time-statistical approach is outlined, in terms of time-averages of certain tracer properties. It results in an ergodic theorem, which gives a general and simple relation between the tracer and the mother substance. Simple equations are presented for the determination of pool-sizes and for the determination of certain tracer dynamic parameters that characterize the turnovers of the considered metabolites. The theory appears applicable under experimentally modest conditions. It is also shown that the tracer dynamics contains the classic physicochemical kinetics as a special case. The tracer dynamic description of metabolic systems is accordingly consistent with the conceptual background of the well-established kinetics of chemical reactions. (C.H.)

19538 RADIOMIMETIC TOXICITY OF OZONIZED AIR. R. Brinkman, H. B. Lamberts, and T. S. Veninga (Universiteit, Groningen, Netherlands). Lancet, 1: 133-6 (Jan. 18, 1964).

A simple way of detecting a morphological red cell effect of ozone in animals and in man was found, namely, the sphering of erythrocytes. Thus, the new red cell starts circulating as a flat disc and ends as a spherocyte, the change being promoted by exposure to ozone. It was also found that this change in shape of the suspended cells is greatly speeded up by x irradiation in vitro, and that this radioinduced acceleration is sensitized by exposure of the animal to low ozone concentrations. It was shown that in the diluted blood of x-irradiated mice, rats, rabbits, and humans who breathed air containing 0.2 to 0.25 ppm of ozone (which can just be detected by smell) a sphering tendency of erythrocytes develops. A further direct demonstration of structural damage caused by ozone was found in the postmitotic nuclei of myocardial fibers of adult rabbits and mice that were exposed to 0.2 ppm of ozone during five hr per day for three weeks. They show rupture of the nuclear envelope and extrusion of nuclear contents which are never observed in the nuclei of normal fibers, but are very similar to nuclear irradiation effects in patients and in x-irradiated tumor cells. Inbred grey mice exposed to 0.1 or 0.2 ppm of ozone in air for 7 hr/day over three weeks had litters of normal size though the neonatal mortality in the first three weeks was 6.8 and 7.5%, against 1.6% in the controls. In the second litters of parents exposed to 0.1 ppm of ozone in air, this figure was 4.9%. In inbred C57 black mice exposed in the same way to 0.2 ppm of ozone the neonatal mortality in the first three weeks was 34%, against 9% in controls. It is concluded that exposure to low concentrations of ozone, such as produced by commercial ozonizers, is not innocuous. It is noted that health authorities are very much opposed to exposure to the smallest concentrations of oxygen radicals produced by ionizing radiation, whereas they are indifferent or they even encourage the use of an oxidant as powerful and as long-lived as ozone, which is copiously produced at home, in factories, and in hospitals, by so-called fresh air devices. (BBB)

19539 CALCIUM–STRONTIUM DISCRIMINATION IN MINIATURE PIGS AS RELATED TO AGE. R. O. McClellan (General Electric Co., Richland, Wash.). Nature, 201: 104-6(Apr. 4, 1964). (HW-SA-3291)

The age-dependency of Ca–Sr discrimination in miniature pigs was studied. Miniature pigs 15-240 days old were given a single dose of ^{45}Ca and ^{90}Sr in a mild solution by gastric intubation or in a feed pellet with an aliquot of feed depending on age. The highest retention of both radioisotopes was observed in the youngest animals. With increasing age, the percentage retention of both decreased with the most marked change occurring in animals dosed between 15 and 45 days of age. Although it was not possible

to define precisely the basis for the change in discrimination, several factors appear to be contributory. Changes in the absorptive mechanism of the younger animals and changes in skeletal turnover rates of the two radioisotopes with time appear to be major factors in the changing discrimination. (P.C.H.)

19540 EFFECT OF INSULIN ON ACCUMULATION OF RADIOACTIVITY FROM AMINO-ACIDS BY ISOLATED INTACT RAT DIAPHRAGM. Ira G. Wool (Univ. of Chicago). Nature, 202: 196-7(Apr.11, 1964).

Tests were made on the response to insulin of six amino acids. As a result, threonine and hydroxyproline were added to the list of amino acids the entry of which into muscle is stimulated by insulin; in addition, one amino acid (serine) previously considered not responsive was found to be so. Insulin did not stimulate accumulation by isolated intact diaphragm of radioactivity from labeled L-arginine, DL-tryptophan, L-isoleucine, or DL-cystine. However, the hormone significantly increased incorporation of radioactivity into protein from each of the amino acids tested without regard to whether penetration into muscle was enhanced. (P.C.H.)

19541 A SIMPLE METHOD FOR ESTABLISHING STABLE CONCENTRATIONS OF RADIOACTIVE CALCIUM, STRONTIUM AND PHOSPHORUS IN THE PLASMA OF GOATS AND COWS. B. F. Sansom (Agricultural Research Council Inst. for Research on Animal Diseases, Compton, Berks, Eng.). Nature, 202: 205-6(Apr. 11, 1964).

A simple method for establishing a constant concentration of a radioactive tracer in the blood plasma for periods of several days or weeks is described. The method consists of the subcutaneous injection of a saline suspension of a sparingly soluble compound labeled with an isotope of the element concerned. This acts as a depot of radioactivity from which slow leaching occurs into the blood stream. In the case of Ca, calcium orthophosphate labeled with ^{45}Ca was used as the depot, and for phosphorus the same compound labeled with ^{32}P. Some experiments with Sr were also carried out using strontium sulfate labeled with ^{89}Sr as the depot, and the principle may presumably be extended to other elements of biological interest. (P.C.H.)

19542 DISTRIBUTION OF Po^{210} IN HYPOPHYSIS, THYROID, AND PARATHYROID IN WHITE RATS. A. V. Tkachev. Radiobiologiya, 3: 877-9(1963). (In Russian)

Dynamics of ^{210}Po distribution in hypophysis, thyroid, and parathyroid glands in white rats during radiation sickness were studied using 150- to 200-g female rats injected with 0.017 μC of ^{210}Po.. The maximum accumulation of ^{210}Po was observed in the hypophysis on the 10th day and in the thyroid gland between 10 and 40 days. ^{210}Po has different distributions in the front and back hypophysis, with a sharp reduction in the back portion. After 100 days ^{210}Po is hardly traceable. (R.V.J.)

19543 THE IN VIVO STABILITY OF THE TRITIUM LABEL IN 1,2-H^3-D-ALDOSTERONE WHEN USED FOR MEASUREMENT OF ALDOSTERONE SECRETION RATE BY THE DOUBLE ISOTOPE DILUTION TECHNIQUE. Avinoam Kowarski, Jordan Finkelstein, Bernadette Loras, and Claude J. Migeon (Johns Hopkins Univ., Baltimore). Steroids, 3: 95-107(Jan. 1964).

A mixture of D-aldosterone and 1,2-^3H-D-aldosterone was prepared, and part of this mixture was injected intravenously into two totally adrenalectomized patients. The remainder was retained, its specific activity was determined, and compared with the specific activity of the 3-oxoconjugate of aldosterone which was recovered from urine. The specific activity of the aldosterone released by pH 1 incubation of the urine should be lower than that of the uninjected aldosterone if some of the tritium tag is removed during in vivo metabolism, or if the patients had some residual adrenal tissue capable of producing endogenous aldosterone. The tritium label of 1,2-^3H-D-aldosterone is biologically stable and this compound can be used satisfactorily for the determination of aldosterone secretion rates in man. (BBB)

19544 ON THE QUESTION OF THE METABOLISM OF RADIOPRASEODYMIUM (^{143}Pr) AFTER INHALATION OF LIQUID AEROSOL BY WHITE MICE. Friedrich Gensicke and Hermann-Wolfgang Nitschke (Deutsche Akademie der Wissenschaften, Berlin). Strahlentherapie, 123: 259-66 (Feb. 1964). (In German)

Resorption and distribution of inhaled liquid ^{143}Pr aerosols were investigated in mice. After inhalation, ^{143}Pr was removed very slowly from the lung and stored mainly in liver and skeleton. The activity in the other organs investigated was relatively low. In comparison to ^{144}Ce and ^{91}Y it was observed that, 14 days after inhalation, elimination of the radionuclides from the lung (same particle size of the aerosols) decreased in order from $^{91}Y > ^{143}Pr > ^{144}Ce$; the increase in activity in liver and skeleton showed no significant difference between ^{143}Pr and ^{144}Ce, while ^{91}Y was different. The excretion of the nuclides in the urine and feces increased $^{144}Ce < ^{91}Y < ^{143}Pr$. (auth)

19545 SEX DEPENDENCE OF THE DISTRIBUTION OF RADIO CERIUM IN RATS. Eberhard Schmautz (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 123: 267-78(Feb. 1964). (In German)

The distribution pattern of intravenously injected carrier-free $^{144}CeCl_3$ in rats was found to depend on the sex of the animals. In males, the retention by skeleton and kidneys and the urinary excretion were enhanced, whereas the deposition in the liver was less marked than in females. The elimination from the organs was not influenced by the sex. The sex influence was more pronounced in growing than in mature animals. In principle, the same effect could be achieved by gonadectomy or administration of sex hormones. No influence of the sex could be observed in the case of isotopically diluted ^{144}Ce. (auth)

19546 ROLE OF THE THYMUS IN RESTORATION OF IMMUNE REACTIVITY AND LYMPHOID REGENERATION IN IRRADIATED MICE. Amiela Globerson and Michael Feldman (Weizmann Inst. of Science, Rehovoth, Israel). Transplantation, 2: 212-27(Mar. 1964).

A study was made of the role of thymus in the restoration of immune competence and the regeneration of the lymphoid system in x-irradiated mice. Thymectomy of adult mice followed by total-body irradiation at sublethal doses postponed or abolished the spontaneous reactivation of the homograft reaction against genetically foreign tumors. Retransplantation of intact thymuses can reactivate the immune response. The depletion of the lymphoid system in spleen and lymph nodes of thymectomized and irradiated mice was studied. Following depletion of the lymphatic follicles, erythroblastic noduli proliferate in the spleen. In thymectomized animals, their appearance precedes that of irradiated controls. In spleens of the irradiated animals, erythropoiesis predominated for about four weeks after which regression of erythropoiesis took place with a concomitant regeneration of typical lymphoid follicles. In thymectomized animals, erythropoiesis persisted for a much longer time (two months and more), and following its eventual regression the regeneration of the lymphoid elements was either suppressed or abolished. Regrafting of thymuses to thymectomized animals was

followed by a lymphoid regeneration in the spleen. Tentative interpretation of the results of immune reaction following thymus grafts of isologous and homologous origins seem to support the concept that the thymus induces the differentiation to immune competent cells of lymphoblasts originated in the spleen or bone marrow, rather than being itself a tissue origin for immune competent cells. (auth)

Radiation Effects

19547 (AMRL-TDR-63-71) RADIATION THRESHOLDS FOR CHORIORETINAL BURNS. Hans G. Bredemeyer, Otto A. Wiegmann, Antoine Bredemeyer, and H. Richard Blackwell (Ohio State Univ., Columbus. Inst. for Research in Vision and Ohio State Univ., Columbus). July 1963. Contract AF33(616)-7583. 38p. (AD-416652)

Eyes of live rabbits were epxosed to electromagnetic radiation of different spectral distributions to compare their effectiveness in producing chorioretinal burns when retinal image size and exposure time remained constant. The experiments were limited to the spectral range between 200 and 3000 mμ. A carbon Jet-arc serves as radiation source in most cases. Results were differentiated for three groups of fundus pigmentation. It was found that ultraviolet is virtually ineffective. The effectiveness of the visible and infrared regions of the spectrum is considerably greater, and depends on wavelength: the longer the wavelength the higher the energy threshold measured at the cornea. Present experimental data and related data published by other authors were used to infer a spectral effectiveness function for chorioretinal burns. A separate function is presented for threshold and for suprathreshold burns. The data of this and related experiments are used to derive relations between burn diameter, exposure duration, and burn threshold. A calculational method is described which permits calculation of whether or not a burn is to be expected, based upon physical data on the source such as intensity, size, distance, duration, and spectral composition. (auth)

19548 (BNL-7926) EXTRACORPOREAL IRRADIATION OF THE BLOOD IN THE STUDY OF LYMPHOCYTE PROLIFERATION AND FUNCTION. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 36p. (CONF-487-1).

Applications of extracorporeal irradiation of blood in studies of lymphocyte production and function and fundamental physiological phenomena are discussed. Possible future applications in studies of immune reactions and in the therapy of autoimmune diseases and human leukemia are suggested. (C.H.)

19549 (NP-13857) RADIOBIOLOGICAL DOSIMETRY. Recommendations of the International Commission on Radiological Units and Measurements (ICRU). Report 10e 1962. (National Bureau of Standards, Washington, D. C.). Apr. 30, 1963. 26p. (NBS-Handbook-88)

Radiobiological dosimetry procedures are described. Emphasis is placed on methods for improving the accuracy and intercomparability of absorbed dose measurements. The importance of planning experimental work in such a way as to make dosimetry easier and more accurate is discussed. Data are appended on radiation units and quantities. (40 references.) (C.H.)

19550 (NYO-2181-1) CURRENT DATA FROM THE EPIDEMIOLOGICAL FOLLOW-UP OF THE NEW JERSEY RADIUM CASES. Lester A. Barrer and Elizabeth Z. Stewart (New Jersey. State Dept. of Health. Radium Research Project, West Orange). Oct. 1, 1963. Contract AT(30-1)-2181. 260p.

Data are tabulated from an epidemiological follow-up of cases of radium poisoning in individuals with body burdens of ^{226}Ra and ^{228}Ra. Most of the individuals were exposed while engaged in painting luminous dials with radium paint. Data are included from clinical laboratory studies, dental examinations, inventories of biological specimens and samples, case follow-ups, and death certificates. A coding system is included for the preparation of IBM cards for data tabulation. (C.H.)

19551 (NYO-2762) SURVIVAL EXPERIENCE OF THE RADIUM CASES. Abraham H. Libove and Lester A. Barrer (New Jersey. State Dept. of Health. Radium Research Project, West Orange). Mar. 1963. Contract AT(30-1)-2181. 44p.

Survival data on individuals exposed to Ra were compared with the expected rates computed from the general life tables for New Jersey men and women. This method also served to describe some of the characteristics of the group exposed to Ra. From a group of 921 persons, known to be former employees of the Ra industry, a nonrandom sample of 289 was selected. The basis of selection was that there be available data concerning each individual including: sex, date of birth and date of death or year last known to be alive; as well as data regarding exposure to Ra; i.e., age at initial exposure, year of first exposure, and place, type, length of time and continuity of exposure. No valid statistical relation was established between the sample selected for trial and the total data available. (C.H.)

19552 (NYO-2769-1) [PROGRESS REPORT ON RADIATION EFFECTS ON LIPID METABOLISM]. Final Report. B. Malamos (Athens. Univ.). [1964]. Contract AT(30-1)-2769. 18p.

Studies were made on the effects of radiation on the lipid metabolism of white blood and bone marrow cells. The possibility that alterations on the pattern of the synthesized fatty acids may occur after irradiation was investigated. Only slight differences were found in the irradiated samples. However, the results did show an activation of decosanoic acids (mainly $C_{22:4}$) biosynthesis presumably due to irradiation. The incorporation of palmitic, stearic, and oleic acids in irradiated human bone marrow cells was also studied. It was concluded that the behavior of the cell membranes towards irradiation is dependent on the structure of the fatty acid. Irradiation also did not affect the incorporation of acetate-1-^{14}C into total lipids. The results of studies on the constitution and metabolism of leukocyte lipids are listed. Irradiation of human bone marrow cell cultures with doses ranging from 530 to 2000 rads produced an effect suppressing the rate of fatty acid synthesis by about 30 to 60%, depending on the dose and the time lapse between irradiation and incubation. (P.C.H.)

19553 (TID-20513) IONIZING RADIATION AND REGENERATION IN SALAMANDERS. Final Report. (New York. State Univ., Buffalo). [1963]. Contract AT(30-1)-3027. 11p.

Radiation biology was employed as a tool in studies of cell regeneration. Data are presented from studies on the effects of x radiation on regenerative capacity of salamander tails and limbs after amputation, tracer studies of metabolism in irradiated and nonirradiated salamanders, and the origin of regenerative myoblasts in mice exposed to local doses of 500 to 300 r x radiation before or after muscle wounding. It was found that these energies completely canceled regeneration in the wounds. (C.H.)

19554 (TID-20550) THE EFFECT OF X RADIATION ON LONGEVITY IN DROSOPHILA MELANOGASTER.

Final Technical Report. [Vida G. Wood] (Taylor Univ., Upland, Ind.). Apr. 1964. Contract AT(11-1)-885. 83p.

The length of life of control and irradiated populations of Drosophila melanogaster was investigated over a 4-yr period. Two unrelated wild type strains of flies were crossed and inbred stock from this mating was exposed to doses of x radiation ranging from 25 to 60,000 r. Both mated and unmated groups were studied and radiation exposure was given during each developmental period. The data indicate that females outlive males in both irradiated and control groups, and unmated flies live longer than mated flies. A slight increase in life span was noted in flies exposed to the lowest doses of radiation. Possible explanations are discussed. (C.H.)

19555 (USNRDL-TR-721) A PERSISTENT BONE GROWTH DEFICIT IN THE X-IRRADIATED RAT. R. D. Phillips and D. J. Kimeldorf (Naval Radiological Defense Lab., San Francisco). Feb. 10, 1964. 38p. (AD-434219)

A critical assessment of the roentgenographic technique was made for a quantitative determination of bone and tail length in the rat. The method was found to be very reliable if error sources were controlled and minimized. The early and long term effects of x irradiation on skeletal growth were investigated with respect to the age at exposure. Rats exposed at a juvenile age (37 days) to a sublethal dose (430 rad) exhibited a retardation in femur, tibia, and tail growth within 14 days after exposure. The maximum deficit was attained within 30 days after exposure and remained approximately constant for the next 300 days. Femur and tibia length of animals which were exposed to x rays as young adults (101 days of age) did not differ from those of controls for the first two months after exposure. However, there was a deficit in femur and tibia length in these animals at the end of life span. The magnitude of the bone length reduction at the end of life span was dose dependent. The two major differences in response between the two age groups were the time course of the radiation effect on growth and the magnitude of the deficit. The reduction in bone length occurred faster and was greater in the younger irradiated group. (auth)

19556 (JPRS-23956(p.9-17)) THE EFFECT OF IONIZING RADIATION ON THE REPRODUCTION OF THE VIRUS OF EPIDEMIC PAROTITIS IN WHITE MICE AND GUINEA PIGS. A. G. Moroz and D. I. Ivanovskii (Ivanovskiy). Translated from Vop. Virusol., 9: No. 1, 66-72 (1964).

Mice were irradiated with 300 r of x rays. Forty-eight hours later the animals were inoculated with epidemic parotitis virus after which the presence of the virus in various organs was determined at set intervals. Reproduction of the virus in guinea pigs and pathogenic effects on irradiated guinea pigs were also studied. Multiplying parotitis virus was found more often and for a longer time in the lungs of irradiated mice after intranasal inoculation than in the lungs of nonirradiated animals, that is, up to the ninth to tenth day after inoculation. It was possible to detect parotitis virus only in the lungs of the inoculated mice. Parotitis virus multiplied more extensively in the lungs of irradiated guinea pigs from the third to the sixth day after intranasal inoculation than in the lungs of the nonirradiated guinea pigs. The virus was detected in the lungs of irradiated guinea pigs, on the tenth day after inoculation, and on the second day in the kidneys. The pathogenic action of parotitis virus for irradiated guinea pigs was established. Regardless of a certain lowering of the guinea pigs resistance to parotitis virus under the influence of x-ray irradiation, it was possible to detect multiplication of the virus only in their lungs. (H.M.G.)

19557 (JPRS-23956(p.18-26)) CELLULAR SHIFTS IN LYMPH NODES OF NORMAL AND IRRADIATED ANIMALS VACCINATED AGAINST INFLUENZA. E. (Ye.) I. Sklyanskaya and O. P. Peterson. Translated from Vop. Virusol., 9: No. 1, 83-90(1964).

The plasmacytic reaction in the regional lymph nodes of mice and rats vaccinated against influenza is decreased under the influence of the irradiation of them with sublethal doses of x rays. Preliminary subcutaneous infection of a nonspecific stimulator into the thigh in the form of an oil suspension sharply intensifies plasmacytic shifts in the lymph nodes. With the use of nonspecific stimulation of cellular reactions in the lymph nodes it is possible to weaken the depressing effect of irradiation on the course of the plasmacytic reaction and to activate the formation of immunity. (auth)

19558 (JPRS-24187) A STUDY OF THE MICROFLORA OF GAMMA-IRRADIATED PRODUCTS. F. S. Apt, N. N. Mazokhina, L. P. Naydenova, and V. I. Rogachev. Translated from Mikrobiologiya, 33: 167-71(Jan.-Feb. 1964). 6p. (OTS-64-31076)

The species composition of residual microflora was studied in meat, fish, and green peas placed in hermetic containers and irradiated with doses of 600 to 1500 kilorads. Upon analysis of the meat, fish, and green peas, irradiated by gamma rays and stored for long times without external signs of decay, it was found that the residual microflora appears chiefly as the coccal forms, less often as yeast cells, and much less frequently as bacilli-form bacteria. It was concluded that under the effect of irradiation, some of the spontaneous product microflora change morphological and biochemical properties. (P.C.H.)

19559 SOME IMPLICATIONS OF A NEW INTERPRETATION OF CHROMATID ABERRATIONS INDUCED BY IONIZING RADIATIONS AND CHEMICAL AGENTS. S. H. Revell (Royal Cancer Hospital, London). Abhandl. Deut. Akad. Wiss. Berlin, Kl. Med., 45-6(1960).

In the new interpretation, chromatid and isochromatid discontinuities, which are customarily regarded as surviving single or double primary breakages, are interpreted instead as arising from minute intrachanges which unravel chromosome contraction to metaphase. This hypothesis makes it unlikely that the primary event, occurring just as the chromosome is traversed by the ionizing particle, is an actual chromatid breakage; and also, therefore, unlikely that the conjugation of a pair of such primary events (defined as exchange initiation) consists of a reciprocal chromatid cross-union. Thus, the temporary capacity of an affected chromosome to conjugate with another in an exchange initiation does not consist in a chromatid break remaining open, but, rather, must be some labile tendency to undergo a point-pairing with another site similarly affected. Other implications of this exchange interpretation are also discussed. If the two early stages in exchange induction, i.e. those that are separable by manipulation of the radiation dose, are not chromatid breakage and reunion, then the chromatid exchange itself is structurally established at some later stage. The state of exchange initiation is thus a premutational condition in respect of the subsequent exchange, but it is not yet possible to decide whether an exchange initiation is irreversibly committed to exchange realization. The exchange process is envisaged as developmentally homologous with the meiotic process, and the exchange itself as a subsequent chromosome develop-

ment possibly akin to meiotic exchange. Thus the chromosomes in the nuclear environment are considered to perform the work of the exchange, the chemical or radiation only predisposing them to do so. According to this conception, both primary event and exchange initiation could be of very small magnitude in terms of chemical change, though subject to amplication by subsequent chromosome development. In the exchange interpretation, the spatial arrangement of chromosomes in the resting nucleus is an important factor affecting sensitivity to the induction of all types of chromatid aberration, whereas in the breakage-and-reunion interpretation the component of sensitivity due to simple breakage (and consequent deletion) is unaffected by spatial considerations. The exchange interpretation thus appears to offer greater scope in accounting for large differences in sensitivity, so far as the induction of chromatid aberrations is concerned. (BBB)

19560 SEARCH FOR ANTAGONISTIC ACTINOMYCETAE IN HUNGARIAN SOILS. VI. THE EFFECTS OF BACKGROUND RADIATION ON STREPTOMYCETES. F. Hernadi, P. Kovacs, G. Kulscar, and T. Valyi-Nagy (Medical Univ., Debrecen, Hungary). Acta Biol. Acad. Sci. Hung., 14: 111-21(1963).

Twenty Streptomyces strains isolated from the radioactive soil (8 to 10 mμC) of a U mine were compared with 20 control strains from inactive soils. Macroscopic, microscopic, and electron microscopic morphology of the two groups and their growth on 35 differentiating media were examined. Their fermentation fluids were tested for antibiotic activity against Staphylococcus aureus Duncan, Escherichia coli 0 111, Pseudomonas pyocyanea, Myocobacterium 607, Bacillus subtilis, and the Ehrlich ascites tumor. The radioprotective effects of the fluids were also determined. Between the two groups of isolates only one essential difference was demonstrated; out of the Streptomyces strains exposed to relatively intensive ionizing radiation for many generations, 85% belonged to section I of Pridham's classification, compared with only 26% of control strains. That is, the sporophores of most strains exposed to background radiation are straight and do not form loops or spirals. Pridham's classification scheme is said to be based on evolutionary principles; the groups designated with higher numbers are thought to have attained higher levels of evolution. If so, chronic ionizing radiation would preferably kill cells younger from the evolutionary point of view, and the older cells would have the best chance to survive. However, this assumption cannot be accepted as a general rule unless confirmed by data obtained by finer genetic and biochemical methods on the Streptomyces floras of the radioactive soils of numerous geographical areas remote from each other. These experiments were aimed at finding, in the radioactive soil, strains producing radioprotective substances; however, it appeared that the higher radioprotective activity of certain Streptomyces fermentation liquids could be attributed to the higher metabolic activities of these strains rather than to an adaptation mechanism. (BBB)

19561 STUDIES ON THE COMPOUND LIPIDS FROM X-RAY IRRADIATED ANIMALS. II. BIOLOGICAL AND BIOCHEMICAL PROPERTIES OF THE COMPOUND LIPIDS IN THE X-RAY IRRADIATED RABBIT ORGANS. Sachiko Ohara (Okayama Univ., Japan). Acta Med. Okayama, 17: 63-76(Apr. 1963).

To clarify the mechanism of the indirect tissue damage by radioinduced lipid changes, lipids of rabbits irradiated with 3000 r were fractionated by silicic acid chromatography and tested for biologic activity on cultures of L cells. Postirradiation incorporation of ^{32}P-labeled lipids in tissues was also studied. The lipid (lysophosphatide-rich fraction) isolated from irradiated rabbit organs possessed a strong hemolytic action and an ability to inhibit L cell proliferation as well as to accelerate the respiration of mitochondria in the rabbit liver and spleen. It was also shown that they act as to induce a marked swelling of mitochondria, impeding the formation of high-energy phosphate and acting as an uncoupler of oxidative phosphorylation in vivo. The uptake of ^{32}P-labeled lipids was marked in spleen, bone marrow, and liver of both irradiated and nonirradiated groups. The uptake of ^{32}P-labeled lipids in rabbits given intravenous injections of lipid fractions for 30 consecutive days previously was found to be greatest in pancreas followed by bone marrow, spleen, liver in the male group, whereas it is greatest in spleen, followed by liver and bone marrow in females. It is proposed to lipids liberated and altered by irradiation may act on the bone marrow to depress hematopoiesis. (BBB)

19562 RADIATION AND EAR: EXPERIMENTAL STUDIES. George Kelemen (Los Angeles Foundation of Otology, Calif.). Acta Oto-Laryngol., Suppl., 184: 1-48 (1963).

After a review of previous reports on the effects of ionizing radiations (especially of x rays and Ra) on the ear, results are reported on the effects on the ear of exposure of Sprague-Dawley rats to 2-Mev x rays and ^{60}Co γ radiation. Whole-body doses of 100 to 3000 r were given and histopathologic changes in the ear were examined one to five days later. To avoid the influence of nonradiation pathology (a factor considered to be of great consequence) the findings were tabulated on basis of the infection-free material with comparative data from cases showing disease independent from the radiation effects. Hemorrhage stood out clearly as the principal damage; primary by direct, acute extravasation and secondary by damaged vessels giving way. Tympanic membrane, the mucous membrane lining of the middle ear inclusive of the ossicles, showed engorgement with extravasation. Sometimes the bone was affected by participation of the periosteum in the general process. The inner ear usually remained intact next to a heavily damaged tympanic cavity. Here, damage was manifested as vascular phenomena: perilymphatic edema with compression of the endolymphatic space in the vestibular part and destruction of the elements of the cochlear duct, with exception of the remarkably resistant tectorial membrane, by hemorrhage from the stria vascularis. The basilar and the Reissner membranes remained intact, the latter without exception remaining in the standard position. Most conspicuous was the destruction of the papilla of Corti and surrounding elements in its vicinity, while cristae, inclusive of their cupulae, and maculae proved to be practically unaffected by radiation in the dosage used. On the other hand, the organ of Corti, while in many instances being destroyed next to intact vestibular end organs, was in other cases intact next to massive infection in the adjacent middle ear. In different cochlear turns, the organ of Corti showed different degrees of disintegration, the apical turn generally containing the organ with least damage. Previous reports were confirmed as to hemorrhages, while earlier findings regarding the sensory end organs were difficult to evaluate because of nonradiation effects. (BBB)

19563 PERSISTING CHROMOSOME ABERRATIONS IN CELL CULTURES FROM IRRADIATED HUMAN SKIN. Jakob Visfeldt (Radium Center, Copenhagen). Acta Pathol. Microbiol. Scand., 59: 556-7(1963).

Chromosome patterns were studied in cultures in cells biopsied from skin before and after exposure to 100-r doses of 100-kv x-ray therapy. Minor numbers of chromatid aberrations were noted both in the irradiated biopsies and in the unexposed samples, and differences, whether qualitative or quantitative, could not be definitely ascertained. Various chromosome aberrations were demonstrable in the irradiated biopsies but not in the nonexposed specimens. The frequency of mitoses involving aberrations was highest in the biopsy taken 24 hr after irradiation; it was slightly lower in the biopsy taken 3 hr after irradiation; a considerably lower frequency was seen in the biopsy taken 72 hr after irradiation. About 10% of the mitoses presented one or more aberrations. Chromosome aberrations could be classified into a few main groups. Translocation was manifest in the form of chromosomes in which one pair of arms was appreciably longer than that of the homologous chromosome, as seen in chromosome numbers 1, 2, 4-5, and 13-15 (Denver classification). Mitoses was found in which the normal numerical distributions on groups (6-12), (17-18), and (16, 19-20) was absent, indicating reciprocal translocation of the smaller chromosome. Isolated mitoses presenting similar shifts were demonstrable, however, in the unexposed biopsy, and thus these variations were not classified as aberrations. Some aberrations in the form of pericentric inversions were visible, but only on the large chromosomes. Deletion represented a common type of aberration; generally the site of fragmentation on one pair of arms was localized close to the centromere. The deleted fragments could not be traced and was perhaps lost during previous cell divisions. Development of one, and probably of several clones was noted, the same characteristic chromosome aberrations being repeated in a series of cells from various subcultures originating the same biopsy. Thus in vivo irradiation (100 r) of skin was found to induce development of chromosome aberrations persisting in cell cultures after cultivation for long periods (2 to 4 weeks). (BBB)

19564 EFFECT OF RADIOACTIVE RADIATION ON CARDIAC ACTIVITY. A. Niedetzky and Maria Hajnal-Papp (Medical Univ., Pecs, Hungary). Acta Physiol. Acad. Sci. Hung., 23: 315-22(1963).

The problem of the effect of radiation on cardiac activity is still unclear. The experimental results described previously and in the present report indicate, however, that such effects should be taken into consideration. The resul also suggest the involvement in the effect of some trace elements. It is likely that in these experiments, the effect of β radiation as well as contaminants emitting α rays were also involved. The problem cannot be considered to be solved, because thus far it has not been possible to reproduce earlier results. Other factors, too, may play a role, and these should be examined in further experiments. The decisive-role in the effect is thought to be played by radiation. (auth)

19565 SUCCESSFUL PREGNANCY AFTER RADIATION THERAPY FOR CARCINOMA OF THE CERVIX. James A. Whelton and Daniel J. McSweeney (Tufts Univ., Boston). Am. J. Obstet. Gynecol., 88: 443-6(Feb. 15,1964).

Radiosensitivity of the ovary is considered, and the possibility of recovery of ovarian function following pelvic radiotherapy is evaluated with reference to previously reported cases and a new case. In the standard radiation program of combined Ra and x-ray therapy currently employed for the control of carcinoma of the cervix, the amount of radiation delivered to the gonads makes preservation of ovarian function nearly impossible. Even after Ra therapy alone for cervical cancer, continued ovarian activity as evidenced by regular menstruation is infrequent, and successful pregnancy after Ra treatment for a malignant growth on the cervix is an extremely rare occurrence. Data are tabulated for nine previous cases in which pregnancy occurred after radiotherapy for cervical carcinoma. In the present case, a 21-yr-old women was treated with 5000 mg-hr and became pregnant twice, four and six yrs later. No external x-ray therapy was given. The patient experienced vaginal bleeding consistent with a menstrual period in each of the first two months after Ra insertion but had total amenorrhea for the next year. Rectal bleeding and diarrhea six months later because of radiation proctitis. A cervical biopsy performed three yr later showed a severe radiation reaction. Regular menses commenced four months after this procedure. Both pregnancies terminated prematurely but in both instances an apparently normal infant was born, and no subsequent abnormalities in their growth, development, or behaviour were noted. In the reviewed group of cases, preservation of ovarian function was attributed in great measure to the increased distance of the ovaries from the Ra source because of an intrauterine gestation (five cases), recent parturition (one case), recent miscarriage (one case), and a large exophytic tumor (one case). The existence of an amenorrheic state for nine months in one earlier case and for 12 months in the present case indicates that the radiosensitive gonads were significantly affected by the action of radiation. The relative youth of these two patients may have played a role in the capacity of their ovaries to reestablish ovulation. The effect of radiation on the function of cervical dilatation in parturition was also discussed after a study of these cases. Because of radioinduced scarring of the cervix, cesarean section is usually necessary for delivery in such cases. Among the 10 children who were born of these mothers whose ovaries had received a subliminal castration dose of radiation there was no evidence of any gross congenital defect, but the follow-up on all of these children is incomplete and the possibility of a genetic defect in a future generation cannot be ruled out if children should be born to any of these individuals. (BBB)

19566 RADIATION PNEUMONITIS: CASE REPORT OF BILATERAL REACTION AFTER UNILATERAL IRRADIATION. J. Chandler Smith (Western Reserve Univ., Cleveland). Am. Rev. Respirat. Diseases, 89: 264-9(Feb. 1964).

The pathology of lung changes following radiotherapy is considered with reference a case report and similar cases reported in the literature. The case presented suggests a mechanism by which the ionizing injury produces these reactions. In a 4-yr-old child, irradiation of the mediastinum and right lung for lymphosarcoma was followed by progressive respiratory distress and death. The central tissue dose of 200-kv x rays was 2915 r. Autopsy examination revealed radiation pneumonitis of the right lung and an equally pronounced and indistinguishable reaction of the left lung. It is suggested that the bilateral reaction was due to blockage of the outflow tract for alveolar macrophages in a dynamic cell system in which cell renewal is in balance with cell depletion. It is also suggested that the critical factor in the pathogenesis of the early stage of radiation pneumonitis may be the patency of the lymph vessels that drain the lung. This interpretation differs from the conventional interpretation of the early stage in that the increased number of macrophages in the pulmonary tissue represents a proliferative response of the alveolar lining cells to radiation injury. However, pronounced prolifera-

tion of cells after high doses of x irradiation is incompatible with its prominent mitosis-inhibiting effect, and the development of the reaction outside the area of exposure further indicates some mechanism other than a primary effect of the physical agent. (BBB)

19567 EFFECT OF IONIZING RADIATION ON AN APPLE TREE CHIMERA. L. Decourtye (Station de Recherches d'Arboriculture Fruitière, Angers, France). Ann. Amelioration Plantes, 13: 133-40(1963). (In French)

A chlorophyll deficiency, appearing in the deeper layers of an apple tree, was observed in a stool-bed of the MM 112 rootstock. This chimerical mutant was irradiated with γ rays at a dose of 5000 r. The following year, white or green homogeneous shoots were observed, the last ones being quite similar to the normal MM 112. In other cases, a new repartition between green and white tissues was observed, giving rise to two new chimeras. In regards with Dermen's histogenics layers hypotheses, one of this chimera could be of the type white-white-green, while the other, more complicated, could be of the type green-green-white-white. This action pattern of irradiation may allow thickening and stabilization of practical useful ectochimeras and also to isolate possible mutations appearing in the deeper layers of the most widely grown varieties. (auth)

19568 MYELOFIBROSIS WITH MYELOID METAPLASIA IN SURVIVORS OF THE ATOMIC BOMB IN HIROSHIMA. Robert E. Anderson, Takashi Hoshino, and Tsutomu Yamamoto (Atomic Bomb Casualty Commission, Hiroshima). Ann. Internal Med., 60: 1-18(Jan. 1964).

The clinical and autopsy findings of 12 patients with idiopathic generalized myelofibrosis with myeloid metaplasia autopsied over a 10-yr period at the Atomic Bomb Casualty Commission (ABCC), Hiroshima are summarized. Ten of the patients were exposed to ionizing radiation at the time of the atomic bomb in 1945. The autopsy incidence in these 10 exposed patients was shown to be inversely proportional to the distance from the hypocenter with the highest incidence among those survivors most proximally exposed. The autopsy prevalence of myelofibrosis among members of the exposed population was found to be 4½ times greater than among the nonexposed autopsy population at ABCC and 18 times greater than the autopsy incidence throughout the remainder of Japan. Although the present report strongly implicates ionizing radiation in the development of at least some cases of myelofibrosis, it does not exclude the possibility of other or even synergystic agents. No relation between degree of exposure and time of onset of symptomatology was found. Integration of the present data with the current concepts of myelofibrosis and the myeloproliferative disorders is discussed. (auth)

19569 PHYSICAL FACTORS AND MODIFICATION OF RADIATION INJURY. Papers from Conferences held by The New York Academy of Sciences Nov. 29, 30 and Dec. 1, 1962 and from a Joint Session with the Academy's Conference on Dec. 1 and Separate Sessions held at Sloan Kettering Inst. for Cancer Research, Dec. 2-3, 1962. Harold E. Whipple, ed. Ann. N. Y. Acad. Sci., 114: 1-716(Mar. 31, 1964).

Sixty-three papers were presented. Abstracts were prepared for 50, the remainder appear in NSA as 17: 7789, 7802, 10358, 12123, 13987, 14087, 15643, 15804, 28666, 30286, 35615, 40660, and 18: 3493. (H.M.G.)

For abstracts of individual papers see: 19511, 19523, 19524, 19525, 19526, 19527, 19570, 19571, 19572, 19573, 19574, 19575, 19576, 19577, 19578, 19579, 19580, 19581, 19582, 19583, 19584, 19585, 19586, 19587, 19588, 19589, 19590, 19591, 19592, 19593, 19594, 19760, 19761, 19762, 19763, 19764, 19765, 19766, 19767, 19768, 19769, 19770, 19771, 19772, 19773, 19774, 19775, 19776, 19777, and 19816.

19570 CORRELATION OF RADIATION QUALITY AND BIOLOGICAL EFFECT. Harald H. Rossi (Columbia Univ., New York). Ann. N. Y. Acad. Sci., 114: 4-15(Mar. 31, 1964).

Adequacy of dose-effect curves for supplying a complete and accurate picture of damage hinges of two important variables: interpretation of the interaction process (whether multitarget or multihit), and assessment of the quality of radiation involved. Radiation quality is discussed from the point of view of linear energy transfer for both single- and multihit concepts. (H.M.G.)

19571 SOME MOLECULAR AND CELLULAR EFFECTS OF HEAVILY IONIZING RADIATIONS. C. A. Tobias and Thomas Manney (Univ. of California, Berkeley). Ann. N. Y. Acad. Sci., 114: 16-31(Mar. 31, 1964).

The present status of macromolecular research with heavy ions and a comparative account of the cellular effects are described. Effects of heavy ions on macromolecules were studied via enzyme inactivation, the dose-effect relation for which was usually found to be exponential. Radiosensitivity modification in macromolecules is discussed. Cellular effects of heavy ions are reviewed in terms of linear energy transfer. (H.M.G.)

19572 THE RESPONSE OF MAMMALIAN TUMOR CELLS IN VIVO TO RADIATIONS OF DIFFERING IONIZATION DENSITIES (LET). Roger J. Berry (Churchill Hospital, Oxford) and J. Robert Andrews. Ann. N. Y. Acad. Sci., 114: 48-59(Mar. 31, 1964).

The response of mammalian tumor cells to ionizing radiation was studied in vivo, using the transplantability of leukemic ascites cells as a measure of cell-reproductive capacity. The relative effects of radiations having a wide range of ionization densities (LET) were assessed under oxygenated and anoxic irradiation conditions. Low-LET radiations give dose-response curves with a shoulder, indicating ability of cells to recover from sublethal irradiation effects when doses are fractionated, while high-LET radiation produces an exponential survival curve and no recovery between fractions. Low-LET radiations are much influenced by the presence or absence of oxygen (oxygen-effect ratio 2.1 : 2.3), while high-LET radiation effects are little modified by the presence or absence of oxygen (oxygen effect ratio 1.2). Considerations for the use of high-LET (densely ionizing) radiations in radiotherapy of human cancer are discussed. (auth)

19573 GENETIC DAMAGE AS A FUNCTION OF LET. M. L. Randolph (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 85-95(Mar. 31, 1964).

Treatment of radiobiological data taken with different LET distributions in order to determine the true curve of response versus LET is demonstrated. For chromosomal aberrations in Tradescantia neither the energy average nor the track average LET is appropriate for plotting data. For chromatid aberrations in Tradescantia an empirical fit was obtained with a marked peak in sensitivity near 65 kev/μ. Finally, general speculations on the variation of radiosensitivity with LET are offered. (auth)

19574 DOSE-RATE DEPENDENCE OF INSTANTANEOUS PHYSIOLOGICAL RADIATION EFFECTS. O. Hug (Universitat, Munich). Ann. N. Y. Acad. Sci., 114: 169-72 (Mar. 31, 1964).

Nastic movements in Mimosa pudica were induced by x radiation. Using short radiation impulses of 10 to 30 sec and doses up to 120 kr/min, the leaflets were observed to close and the stem to bend in the main joint during the first minute. After irradiation of parts of the leaflet, the reaction spreads along the physiological pathways as in any other stimulus. When the action potential is completed, slow depolarization continues and reaches a maximum, finally returning to the initial value in about two hr. The effect was found to be dose-dependent. It is hypothesized that either a direct physicochemical change of the cell membrane or a damage of substances which influence the function of the cell membrane is induced by the irradiation. (H.M.G.)

19575 SOME OBSERVATIONS AND AN HYPOTHESIS CONCERNING THE EARLY STAGES OF RADIATION RECOVERY. Robert F. Kallman and Giovanni Silini (Stanford Univ., Palo Alto, Calif.). Ann. N. Y. Acad. Sci., 114: 173-84(Mar. 31, 1964).

Data are presented relating to the fluctuations in radiosensitivity, as determined by the acute LD_{50}, of two inbred strains of mice within the four days following conditioning whole-body irradiation. The kinetics of this recuperative process are typified by an initial minimum in radiosensitivity, succeeded by a rise to a maximum, terminating in a progressive return to the preirradiation level. A review of the relevant literature reveals the same kind of kinetics in other systems. It is therefore suggested that this is a general phenomenon applicable to the effects of divided doses of radiation on mammalian cell reproductive integrity. An hypothesis is proposed to account for these recuperation kinetics, based largely upon the evidence for generation phase-dependent radiosensitivity differences in division delay and survival of cell reproductive integrity. (auth)

19576 FRACTIONATED, LOW DOSE-RATE IRRADIATION OF MICE WITH FISSION NEUTRONS AND Co^{60} GAMMA-RAYS. Howard H. Vogel, Jr. and Donn L. Jordan (Argonne National Lab., Ill.). Ann. N. Y. Acad. Sci., 114: 185-8(Mar. 31, 1964).

Data are presented on the comparative effects of fission neutrons and ^{60}Co γ rays on lethality in CF1 mice. Exposed female mice received 13 weekly doses of 300 rads delivered in one, three, or six equal fractions per week; or 60 rads of fission neutrons delivered weekly in one, three, or six fractions. All animals were exposed in the gamma-neutron radiation chamber at the CP-5 reactor. Fission neutrons were found to be three times as effective as γ rays for acute 30-day lethality. Thymic lymphomas were the leading cause of death in the neutron-irradiated mice, but γ-irradiated animals, dying much earlier than the neutron-irradiated ones, did not live long enough to develop such tumors. (H.M.G.)

19577 MYELOID LEUKEMIA IN THE MOUSE. A. C. Upton, V. K. Jenkins, and J. W. Conklin (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 189-202(Mar. 31, 1964).

The incidence of myeloid leukemia is elevated in RF mice acutely exposed early in adult life to 50 to 400 rads of whole-body x radiation. The relation between incidence and dose is complex, the yield of leukemias declining as the dose is increased above an optimal level. X rays and γ rays are less leukemogenic when administered daily at low dose rates than when administered in one or two large exposures at high dose rates. The leukemogenic effectiveness of fast neutrons depends on the neutron energy but appears generally comparable to that of x rays. In contrast, however, the effectiveness of fast neutrons shows no detectable reduction with decrease in dose rate. A given dose in air to part of the body is less leukemogenic than the same dose in air to the whole body, but quantitative data on the relative importance of the integral dose and of the volume and region of the body irradiated are not available. The average induction period of leukemia after whole-body x irradiation is 6 to 12 months depending on the dose, although the earliest radiogenic leukemias become detectable within two months. In contrast to the relatively long average latency of leukemia induced by irradiation, the neoplasm appears in a significant number of nonirradiated recipients within one month after injection of cell-free filtrates of leukemic tissue. The age-specific death rate from the disease is biphasic. Radiation markedly advances the onset of the early peak, which occurs in controls between the fifteenth and eighteenth months of life. Radiation affects the late peak (occurring at 22 to 24 months) relatively less, if at all. The results of these studies suggest that the leukemic transformation induced by radiation evolves through multiple changes rather than through a single, one-hit type of alteration in a host cell or in the virus-host relation. (auth)

19578 ROLE OF MOUSE LYMPHOMA VIRUS IN INDUCTION OF MYELOID LEUKEMIA BY X-RAY. K. Yokoro, H. Takemoto, and A. Kunii (Columbia Univ., New York). Ann. N. Y. Acad. Sci., 114: 203-12(Mar. 31, 1964).

In experiments on the induction of leukemia in male adult Rf mice by radiation or radiation plus Gross virus and on the recovery of virus from the leukemic mice, it was found that the lymphoma virus of Gross alone is not leukemogenic in adult Rf mice but that it enhances the induction rate of myeloid leukemia by radiation. It was also concluded that thymectomy prevents the induction of thymic lymphoma by radiation in both normal and virus-infected mice. It enhances markedly the induction rate of myeloid leukemia by radiation and perhaps even that by radiation plus Gross virus. Attempts to recover the causative virus from radioinduced Rf mouse leukemias were suggestive but not conclusive. In contrast, virus could be recovered from virus-infected Rf mice that developed leukemias. (auth)

19579 LEUKEMOGENESIS IN MAN. P. R. J. Burch (Univ. of Leeds, Eng. and General Infirmary, Leeds, Eng.). Ann. N. Y. Acad. Sci., 114: 213-24(Mar. 31, 1964).

A theory based on the analysis of spontaneous human leukemogenesis appears to offer a satisfactory interpretation of the phenomenon of radiation leukemogenesis in man. (auth)

19580 CURRENT STATUS OF ABCC-NIH STUDIES OF CARCINOGENESIS IN HIROSHIMA AND NAGASAKI. L. J. Zeldis, S. Jablon, and M. Ishida (Atomic Bomb Casualty Commission, Japan and National Inst. of Health, Tokyo). Ann. N. Y. Acad. Sci., 114: 225-40(Mar. 31, 1964).

Data suggest that a carcinogenic effect is apparent under the conditions of radiation exposure that occurred in Hiroshima. The evidence does not yet demonstrate such an effect in Nagasaki, possibly due in part to limitations of the study methods in the smaller population. The effect recognized in Hiroshima is thus far small. Longer study is needed for more definitive evaluation of the magnitude of effect, of questions of site-specificity and dose-effect relations. (auth)

19581 THE HIROSHIMA AND NAGASAKI DATA AND RADIATION CARCINOGENESIS. L. D. Hamilton (Sloan-Kettering Inst. for Cancer Research, New York). Ann. N. Y. Acad. Sci., 114: 241-8(Mar. 31, 1964).

Reports collected by the Hiroshima city-wide tumor-registry indicate an increase in reported malignancies.

Although the incidence of leukemia among survivors within 1500 m of the hypocenter is small, it is greatly increased in all age groups, the most significant increase being in the 0 to 9 age group. Relative radiosensitivities of fetus and adult are discussed. (H.M.G.)

19582 CHROMOSOME ABERRATIONS IN IRRADIATED HUMAN SUBJECTS. Michael A. Bender (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 249-51 (Mar. 31, 1964).

Somatic chromosomes were studied in men 29 months after accidental exposure to whole-body irradiation. Using the peripheral leukocyte technique of Moorhead, rings, dicentrics, and deletions were observed in all but the lowest dose case. A second study of leukocytes of the men made 42 months after the accident yielded virtually the same results as the 29-month study. Peripheral blood samples were studied at four hours and at 2, 4, and 10 weeks in men exposed to mixed γ and neutron irradiation. In the first three samples, the aberration frequencies remained approximately constant, but dropped in the last sample. Deletion and dicentric frequencies are presented. A third group of men received whole-body irradiation in an incident involving only γ radiation. Samples were analyzed three days after the accident for deletion and dicentric frequencies. (H.M.G.)

19583 CHROMOSOME CHANGES FOLLOWING IRRADIATION IN MAMMALS. Peter C. Nowell (Univ. of Pennsylvania, Philadelphia), David A. Hungerford, and Leonard J. Cole. Ann. N. Y. Acad. Sci., 114: 252-8(Mar. 31, 1964).

Four mice examined three to 18 months after recovery from sublethal x irradiation were found to have stemline of abnormal cells in the marrow, spleen, thymus, and lymph nodes. Clones with demonstrable chromosome abnormalities comprised from 10 to 83% of the dividing cells in these organs, with the same stemline often recognizable in more than one tissue. Both balanced and unbalanced abnormalities were observed. In none of the animals was there evidence of leukemia. Similar changes were seen in leukocyte cultures from two patients who were treated with x rays and ^{32}P. Chromosome abnormalities reported in radioinduced leukemia are reviewed, and the significance of such abnormalities is discussed. (H.M.G.)

19584 HEMATOLOGICAL RESPONSES TO INHOMOGENEOUS AND HOMOGENEOUS WHOLE-BODY IRRADIATION. James B. Dealy, Jr. (Harvard Univ., Boston and Peter Bent Brigham Hospital, Boston, Mass.), and M. Tubiana. Ann. N. Y. Acad. Sci., 114: 268-83(Mar. 31, 1964).

Effects of homogeneous radiation were compared to effects of inhomogeneous radiation in uremic patients irradiated in attempts to increase the receptivity of renal homografts. Homogeneous radiation was given by means of an 1800-C ^{60}Co source, and inhomogeneous radiation from a 250-kv orthovoltage source. The hematologic picture was observed in patients receiving both types of irradiation, and it was concluded that the hematologic response patterns of the platelets, the granulocytes, and the lymphocytes are remarkedly similar in patients exposed to inhomogeneous and homogeneous whole-body irradiation. Further, the similarity was found to prevail despite other variables in physical factors such as differences in quality of radiation, differences in absorbed dose over a range of 240 to 450 rads, and differences in protraction and fractionation over a period of up to one week. (H.M.G.)

19585 COMPARATIVE EFFECTS OF 50 KVP AND 250 KVP X-RAYS ON THE DOG. E. L. Alpen and S. J. Baum (Naval Radiological Defense Lab., San Francisco). Ann. N. Y. Acad. Sci., 114: 284-301(Mar. 31, 1964).

The leukocyte response of dogs exposed to 50-kv x rays of whole-body irradiation exhibits a similar response to that seen in dogs receiving upper-body exposure of more penetrating x rays in lower total dose. This is considered to be due to the capacity of unirradiated bone marrow to respond to the stimulus of gross infection. (auth)

19586 THE EFFECTS OF PARTIAL-BODY IRRADIATION ON DELAYED RESPONSES. Arland L. Carsten and J. R. M. Innes (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 114: 316-27(Mar. 31, 1964). (BNL-7131)

A series of studies involving the partial-body and partial-brain irradiation of rats and monkeys has yielded the following information concerning delayed effects. Rats receiving 650 rads to the lower body showed a transient weight loss followed by a return to normal growth pattern, whereas animals receiving 1300 rads upper-body exposure exhibited a similar early weight loss, and in addition a permanent impairment of growth. Exposures of 650 rads upper body or 1300 rads lower body resulted in no acute deaths in rats, but did cause an equal and significant lifetime shortening. The above exposures resulted in a hastening of the appearance of tumors in the irradiated animals as compared to the unirradiated controls. Rats or monkeys receiving x-ray doses in the 2000 to 4000-rad range to the spinal cord developed, after a period of five to nine months, a lesion of the spinal cord characterized by hind-limb paralysis and loss of sphincter control of bladder and rectum. The clinical signs could be related to a demyelinating lesion affecting the ventral and lateral columns of white matter, proceeding to malacia and liquefaction. Monkeys receiving 3500-rad x-ray exposures to a limited portion of the brain began to show EEG changes after six to eight weeks, followed by clinical changes at three months. Pathology of the irradiated brain was characterized by necrobiotic lesions and gross swelling of the cortical or subcortical structures, circumscribed and confluent areas of demyelination, zones of reactive astrocytic response and a variety of vascular changes. (auth)

19587 DELAYED RADIATION EFFECTS IN ABDOMEN-IRRADIATED RATS. S. Tom Taketa (Naval Radiological Defense Lab., San Francisco). Ann. N. Y. Acad. Sci., 114: 328-34(Mar. 31, 1964).

Two series of studies were conducted in adult male Sprague-Dawley rats exposed to x radiation, one involving exposure of the intact abdomen to 850 rads and the other, exposure of the abdomen exclusive of the gastrointestinal tract to 1300, 3500, or 5000 rads. In both cases, the head, forelegs, and thoracic area were shielded during irradiation. Abdomen-irradiated animals were divided into two groups one of which was treated with antibiotics. The most prominent observation in the abdomen-irradiated animals was the high incidence of tumors, and it was found that prior treatment with antibiotics had no apparent influence on either the pattern of delayed radiation mortality or tumorigenesis. Results in the abdomen-irradiated animals also suggest that an animal with a relatively high radioresistance to intestinal injury does not necessarily have a high resistance to delayed effects of radiation. Gastrointestinal tract shielding was found to increase the lifespan of animals abdominally irradiated. Gross and histological examinations were made to determine the possible cause of death in the gastrointestinal shielded irradiated rats, and the results strongly suggest the involvement of gross kidney pathology as one of the major causative factors in animals receiving 1300- and 3500-rad doses, but cause of death in animals of this group given 5000 rads was not readily apparent. (H.M.G.)

19588 SEQUENTIAL MANIFESTATIONS OF ACUTE RADIATION INJURY VS. "ACUTE RADIATION SYNDROME" STEREOTYPE. M. Ingram, J. W. Howland, and C. H. Hansen, Jr. (Univ. of Rochester, N. Y.). Ann. N. Y. Acad. Sci., 114: 356-67(Mar. 31, 1964).

Danger in viewing the acute radiation syndrome as a stereotype was emphasized by the Lockport incident. Aspects of the acute radiation injury problem arising from study of the accident are: radiation workers are unlikely to receive uniform whole-body exposure to homogeneous radiation; the clinical course after accidental exposure is far less likely to fit a pattern predicted from observations on uniform whole-body exposure; acute radiation injury may give rise to a long, uninterrupted sequence of clinical manifestations of the injury; and differences exist between treatment of mass casualties and treatment of relatively few casualties resulting from occupational exposure. (H.M.G.)

19589 STUDIES ON THE ONTOGENY OF TRANSPLANTATION ANTIGENS IN MICE. G. Doria (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 442-3 (Mar. 31, 1964).

The development of transplantation antigens in mice was investigated by studying the capability of hemopoietic tissues to induce homotransplantation immunity as a function of their age. The method used was based on the fact that lethally irradiated mice are able to reject homologous bone marrow if they have been preimmunized to hemopoietic tissues of the same donor strain. Bone-marrow rejection was estimated by measuring ^{59}Fe uptake in erythocytes of the irradiated recipients. The hemopoietic tissues studied were: C3H fetal (13½-, 15½-, 17½-day-old) liver; neonatal (19½-day-old) liver; and adult (90-day-old) spleen. The method consisted of injecting different cell numbers of either tissue into groups of LAF_1 mice. These and noninjected LAF_1 mice (control group) were given an x-ray total-body dose of 800 r 24 hr later. All the mice were injected with a challenge dose of C3H bone marrow within 2 hr after irradiation, and with a tracer dose of ^{59}Fe nine days after the bone-marrow injection. Radioactivity was measured in a blood sample taken 24 hr after injection of the isotope. The degree of antigenicity of the tissues studied was estimated by the ratio of the ^{59}Fe uptake in the group of mice injected with any dose of the tested cells to the ^{59}Fe uptake in the control group of noninjected mice: the smaller the ratio, the greater the antigenicity. The antigenicity of fetal and neonatal livers, when compared to that of adult spleen as to 100%, were: 0%, 13½ day; 5%, 15½ day; 8%, 17½ day; 16%, 19½ day. By use of proper controls it was possible to reject the hypothesis that the measured antigenicity was a result of further development of the injected cells, which could have grown in the recipient during the time of the experiment. (auth)

19590 METABOLISM OF SERUM PROTEINS IN THE RAT/MOUSE CHIMERA. Wallace Friedberg, John K. Abbott, Mary H. Friedberg, and Donald N. Faulkner (Federal Aviation Agency, Oklahoma City, Okla). Ann. N. Y. Acad. Sci., 114: 480-6(Mar. 31, 1964).

In the rat/mouse chimera, there is a sustained increased fractional rate of albumin catabolism from early in the second week after x irradiation and bone-marrow implantation until at least the tenth week. The major contributing factor may be excessive loss of albumin through leakage into the gastrointestinal tract. The resulting decreased albumin pool and concentration probably stimulates synthesis but not sufficiently to compensate for the albumin loss, at least at the time the measurements were made. It is also of interest that synthesis of β-globulin glycoprotein is increased in the rat/mouse chimera. (auth)

19591 TRANSPLANTATION OF PERITONEAL CELLS. J. W. Goodman (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 496-8(Mar. 31, 1964).

Serological methods were used to establish the strain of origin of erythrocytes and leukocytes in mice given a lethal dose of irradiation and a single injection of peritoneal cells. F_1 hybrid mice were used as donors, and cells were obtained by washing the peritoneal cavity with heparinized saline. The usual yield was 3 to 5 million cells per young adult donor. In all experiments ^{59}Fe uptake was measured within the second week after transplantation. When appreciable uptake was found, reaction of the cells with donor-specific antisera released the label into the lysate, whereas reaction with nonspecific antiserum or nonimmune sera released none of the label. Histologic studies were made on spleen, bone marrow and lymph nodes obtained at autopsy from transplanted, as well as control, irradiated mice. Transplanted mice showed microscopic evidence of erythropoiesis and granulopoiesis in spleen red pulp and bone marrow. Lymphatic tissue proliferation was noted in spleen white pulp and cortex of lymph nodes. Thus, stem cells of the hemopoietic and lymphatic systems are normally present in the peritoneal cavity as well as in bone marrow, spleen, and circulating blood of mice. (auth)

19592 ABSCOPAL EFFECTS AND BONE-MARROW REPOPULATION IN MAN AND MOUSE. N. B. Kurnick and Naime Nokay (Veterans Administration, Long Beach, Calif. and Univ. of California, Los Angeles). Ann. N. Y. Acad. Sci., 114: 528-37(Mar. 31, 1964).

The phenomenon of rapid repopulation of bone marrow in x-irradiated mice was studied by applying fractional high-level irradiation to local sites. Repetitive irradiation to one extremity with doses totaling 4000 and 10,000 r resulted in rapid recovery of the bone marrow. It is suggested that the constant circulation of bone-marrow elements in the mouse may account for the abscopal effects of x irradiation. DNA and DNase assay indicate that population shift may play a role in the biochemical effect, in that cells that may readily be washed out of the spleen by perfusion contain approximately one-third as much DNase as the average of the spleen as a whole. That the cells that can be washed out readily by perfusion are also the cells that circulate normally and are responsible for post-irradiation survival, is indicated by experiments on splenectomized mice given 800-r whole-body irradiation. Defects of the population shift mechanism are discussed. (H.M.G.)

19593 PATTERNS OF HEMOPOIETIC RESPONSE TO CONTINUOUS WHOLE-BODY IRRADIATION. George Brecher, Charles E. Brambel, and Frances D. Brambel (National Institutes of Health, Bethesda, Md. and Univ. of Notre Dame, Ind.). Ann. N. Y. Acad. Sci., 114: 549-56 (Mar. 31, 1964).

Massive splenic erythropoiesis developed in rats during continuous exposure to γ radiation at a rate of 70 r per day. The erythropoiesis was first seen between the fifth and sixth week of irradiation. It was not accompanied by bone-marrow recovery. Granulocytopoiesis and thrombopoiesis as well as erythropoiesis were noted in the spleen and in the bone marrow at 12 to 13 weeks of continuous irradiation. The general problem of development of radioresistant or tolerant hemopoietic cells and the role of the spleen in radioinduced erythropoiesis were discussed. (auth)

19594 UPTAKE OF Fe^{59} BY SPLEENS OF LETHALLY IRRADIATED MICE GIVEN ISOLOGOUS BONE MARROW.

L. H. Smith (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 586-7(Mar. 31, 1964).

An approach to a study of radiation effects on hematopoietic cells, as well as in vitro protection and recovery of irradiated cells, was made in terms of their ability to transplant and proliferate in lethally irradiated mice. The system works reasonably well as a means of estimating in vitro radiosensitivity and protection of mouse bone marrow when 30-day survival of the irradiated recipients is used as an endpoint. Male (C3H × C57BL)F_1 mice were exposed to 950 r of 250-kv whole-body x rays. The next day (~24 hr) these mice were injected intravenously with graded doses of isologous bone marrow cells. Seven days later, 0.2/μC of ^{59}Fe was injected intraperitoneally, and 24 hr later the spleen was removed and counted in a well-type scintillation detector. When results were expressed as percentage-uptake of injected ^{59}Fe, there was a linear response with increasing marrow doses between 0.050 and 0.4×10^6 cells. Over the same range, 30-day survival of lethally irradiated mice increases from a low level to essentially 100% for many strains. It is anticipated that the method will be sensitive enough to study modification of in vitro radiation injury to marrow cells. (auth)

19595 THE BIOLOGY OF RADIATION-INDUCED CANCER. J. F. Loutit (Medical Research Council Radiobiological Research Unit, Harwell, Berks, Eng.). Ann. N. Y. Acad. Sci., 114: 816-22(Apr. 2, 1964).

Biological events involved in the induction of cancer by radiation are reviewed. It is pointed out that at this stage of knowledge it is not possible to do more than to speculate about ways and means. The cancer cell is envisioned as essentially one in which there is genetic imbalance and confounding of nucleic acid metabolism. Gene mutation, chromosome change, DNA viruses, and perhaps DNA transfer from lymphocytes all have an effect on DNA. This in turn affects RNA which may also be disturbed by RNA viruses. In consequence the normal equilibrium of cell functions is altered. As a public health problem it is appropriate to take every practicable step to control initiating agents, amongst which must be included ionizing radiations. However, there is a statistical inevitability of change in aging tissues. Therefore, the prospects of reducing mortality from cancer rest on discovering the factors of promotion, and vital processes which normally hold atypical and antisocial cells in check. (C.H.)

19596 LATE RADIATION EFFECTS OF NEOPLASIA AND OTHER DISEASES IN JAPAN. D. Murray Angevine and Seymour Jablon (Atomic Bomb Casualty Commission, Hiroshima-Nagasaki). Ann. N. Y. Acad. Sci., 114: 823-31 (Apr. 2, 1964).

Data are summarized on pathological conditions found during 1215 autopsies performed from Oct. 1950 through Sept. 1962 on residents of Hiroshima and Nagasaki. The incidence of various diseases was related to the distance of the individual from the hypocenter of the atomic explosions in 1945. No relation was found between radiation exposure and many forms of malignancy found in this sample population. (C.H.)

19597 THE CANCER HAZARDS OF INDUSTRIAL AND ACCIDENTAL EXPOSURE TO RADIOACTIVE ISOTOPES. R. J. Hasterlik, A. J. Finkel, and C. E. Miller (Argonne Cancer Research Hospital, Chicago). Ann. N. Y. Acad. Sci., 114: 832-7(Apr. 2, 1964).

Data are reviewed from studies carried out during the past 27 years on the toxicity of Ra, the incidence of lung cancer in uranium miners, and animal studies on the induction of tumors by inhaled or ingested radioactive materials. The relation between body content and tumor induction in man is discussed. It is pointed out that the sites of tumors induced by Ra are related to the sites of deposition in the skeleton and physical factors concerned with the decay of Ra and Rn in the body. Data on Ra dial painters and U miners constitute all the data available on hazards to man from industrial and accidental exposure to radioactive isotopes. (C.H.)

19598 RADIATION-INDUCED THYROID CARCINOMA. James W. Pifer and Louis H. Hempelmann (Univ. of Rochester, N. Y.). Ann. N. Y. Acad. Sci., 114: 838-48(Apr. 2, 1964).

Epidemiologic studies show a definite relation between thyroid carcinoma and prior radiotherapy for various diseases in childhood. Information regarding such an association for persons treated during adult life is limited and difficult to obtain because of the long period between exposure and tumor development. Nevertheless, there is some evidence that such an association also exists in irradiated adults. None of the prospective investigations has been properly controlled, and for this reason the treated children studied may represent a selected group predisposed to develop thyroid neoplasia without exposure to ionizing radiation. However, two observations provide strong circumstantial evidence that radiation treatment is, indeed, a factor in thyroid tumor induction. First, in the retrospective studies, x-ray therapy was given to the head, neck, and chest for many unrelated conditions. This suggests that the radiation exposure, rather than the disease being treated, is a primary factor in the etiology of the thyroid neoplasia. Second, the development of excessive numbers of tumors can be related to a specific radiologic technique, that is, the use of anterior and posterior ports. Thus, a dose of x rays, if administered one-half to the anterior and one-half to the posterior chest, is associated with a higher thyroid tumor incidence than if given anteriorly only. All of these studies are concerned with radiation from external sources. Insufficient data are currently available to conclude that radioiodine is also oncogenic. More definitive information may be provided when the results of a current national survey of patients treated with ^{131}I are reported. (auth)

19599 EFFECTS OF X RAYS ON THE RIBONUCLEIC ACID OF HELA CELLS. E. V. Boudnitskaya, Maximilienne Brunfaut, and M. Errera (Université, Brussels). Arch. Intern. Physiol. Biochim., 71: 810-11(Nov. 1963). (In French)

Hela cells were irradiated before or after incubation in the presence of cytidine-^3H and studied autoradiographically. The radioactivity was found in the RNA (80%) and DNA (20%). If previously labeled (during 10 or 60 min or 24 hr) cells are irradiated and fixed, in the case of 10-min incubation 100 r decreases nucleolusradioactivity by 20 to 25%, 300 r causes a loss of 40% of activity in the nucleolus and 30% in the rest of the nucleus, and 900 r cause a loss of 60% in the nucleolus and 50% in the remainder of the nucleus. Increasing the incubation time decreases the loss of activity on irradiation; those varieties of RNA which are labeled easily are the most radiosensitive. If the incorporation of cytidine in 10 minutes into irradiated cells is studied, 100 r decreases incorporation in the nucleus (including the nucleolus) by 40%, 300 r by 70%, 900 r by the same amount. Prolonged (1- or 4-hr) incubation causes the decrease to be 25 and 35% for 300- and 900-r doses. For a relatively short period after irradiation, biosynthesis of RNA is retarded. In studies of nuclear RNA radioactivity transfer to cytoplasmic RNA, cells were labeled for 1 hr, then immediately irradiated and incubated in a nonradioac-

tive medium for 4 hr before being fixed. After 100 r, cytoplasmic activity was decreased by 10%; after 300 r, by 40%; after 900 r, by 70%. The greatest part of cytoplasmic RNA is constituted by the ribosomes, and this observation indicates an inhibition of the renewed formation of these. (BBB)

19600 RADIATION-INDUCED HEMORRHAGIC DIATHESIS IN DOGS UNASSOCIATED WITH THROMBOCYTOPENIA: ASSOCIATION WITH AN INTRAVASCULAR PROTEIN-POLYSACCHARIDE PARTICLE. H. S. Winchell (Univ. of California, Berkeley), A. C. Anderson, and Myron Pollycove. Blood, 23: 186-92(Feb. 1964).

Significant thrombocytopenia is not present preterminally in dogs given appropriate doses of ^{90}Y-DTPA irradiation. Nevertheless, these animals have a severe hemorrhagic diathesis at postmortem examination. Dogs systemically irradiated with ^{90}Y-DTPA, and having a terminal hemorrhagic diathesis, demonstrate an intravascular polysaccharide substance at postmortem examination. This polysaccharide has staining characteristics similar to those first reported by Andersen in dogs systemically irradiated with x rays, and more recently observed in the lesions of thrombotic thrombocytopenic purpura. (auth)

19601 RELATIVELY SELECTIVE BETA IRRADIATION OF LYMPHATIC STRUCTURES IN THE DOG USING Y^{90}-DTPA. H. S. Winchell (Univ. of California, Berkeley), Myron Pollycove, A. C. Andersen, and J. H. Lawrence. Blood, 23: 321-36(Mar. 1964).

In an attempt to provide relatively selective irradiation of tissues responsible for the homograft rejection response and to minimize exposure of other radiosensitive tissues, a technique using internally administered ^{90}Y chelated with diethylenetriaminepentaacetic acid (DTPA) was developed. Dogs given sublethal doses of ^{90}Y-DTPA radiation had a benign clinical course, the only remarkable finding being a selective lymphopenia without depression of granulocytes, platelets, or reticulocytes. Dogs lethally irradiated with ^{90}Y-DTPA showed depression of all formed blood elements, and severe depression of lymphocytes was most prominent. As the homograft rejection response appears to be a function of lymphatic tissues, the results obtained suggest the use of this procedure to prepare large mammals for homolcgous tissue transplantation. (auth)

19602 EARLY AND LATE CYTOLOGIC EFFECTS OF WHOLE-BODY IRRADIATION ON HUMAN MARROW. T. M. Fliedner, Gould A. Andrews, Eugene P. Cronkite, and Victor P. Bond (Brookhaven National Lab., Upton, N. Y. and Oak Ridge Inst. of Nuclear Studies, Tenn.). Blood, 23: 471-87(Apr. 1964). (BNL-7224)

Serial marrow studies were performed during the first few days in eight men accidentally exposed to a mixed neutron gamma irradiation. They showed the occurrence of a wave of cytologic abnormalities. These were identical with those seen in animal experiments 1 to 3 days after whole-body irradiation. They were considered to be mitotically connected (M.C. Abn.) and included the occurrence of chromosomal bridges and chromosomal fragments in mitoses. In interphase cells, the main abnormalities were nuclear fragments (karyomeres) in the cytoplasm of erythroblasts, myelocytic cells and lymphocytes; bi- and multinucleated cells; and giant cells. The peak of abnormalities in the erythropoietic forms was reached after 2 days; that in the myelopoietic cells four days after exposure. On the 4th day, there was a distinct dose-dependent difference in these abnormalities between the high dose group (236 to 365 rads) and the low dose group (22-68 rads). Some cytologic abnormalities, as seen in increased regeneratory activity of the marrow, were found in marrow smears 3.5 yr after the accident, although the peripheral blood counts and mitotic indices of the marrow were within normal range. Their significance is obscure. A careful cytologic evaluation of serially aspirated marrow samples during the first hours and days after whole-body exposure proves to be an additional important aid in the assessment of the exposed individual and may well prove to be useful in determining the degree of injury and thus the prognosis. (auth)

19603 LONG-TERM SURVIVAL OF LETHALLY IRRADIATED DOGS GIVEN HOMOGRAFTS OF BONE MARROW. E. Donnall Thomas, G. L. Plain, T. C. Graham, and Joseph W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Blood, 23: 488-93(Apr. 1964).

Chemical, hematologic, biochemical, immunologic, and pathologic data are presented in a group of 15 dogs that survived lethal total-body radiation, 1200 to 1800 r, and a transplant of allogeneic marrow for periods ranging from five months to years. (auth)

19604 THE LYMPHATIC VESSELS IN RADIODERMATITIS: A CLINICAL AND EXPERIMENTAL STUDY. F. R. Wells (Churchill Hospital, Oxford). Brit. J. Plastic Surg., 16: 243-56(July 1963).

The response of human skin to x radiation (7500-r doses), particularly of dermal blood vessels, during radiotherapy was studied in 12 patients by injection of the lymphatic vessels of irradiated skin by a technique modified after Hudack and McMaster. The appearance of skin lesions in the 12 patients with radiodermatitis was compared with those in 57 other subjects following intralymphatic injection of dye. In addition, skin specimens from three patients and seven controls were histologically examined by the dye-iron Prussian Blue technique. Abnormal lymphatic distribution was seen in 11 lesions and another showed borderline abnormality. Three types of lymphatic lesion are described: abnormally superficial long collaterals and slight general dilatation of the superficial plexus; gross lymphedema and lymphangiectasia; and subtotal destruction of the lymphatic network, leaving only occasional collaterals near the edge of the lesion. Three possible mechanisms are suggested: long-term reduction in deep lymphatic drainage, possibly aggravated by destruction of a proportion of the mid-dermal communicating vessels, long-term increases in vascular permeability resulting in permanent lymphatic overload, possibly aggravated by increased blood flow through the telangiectatic, thin-walled vessels; and long-term or even moderately prolonged lymphatic lesion at the superficial or mid-dermal level disrupting the natural protein-removing process which occurs in other inflammatory states. Related investigations in mice showed that lymphatic vessels undergo a phase of increased permeability to dye-iron mixtures which may last up to six hr in the mouse ear following a localized dose of 2000 to 4000 rad. Thus, prolonged protein leakage from the lymphatics (as the result of locally increased permeability) may be an important factor in perpetuating postirradiation skin lymphedema and the accompanying dermal fibrosis. The results suggest that this dye injection technique may be of value in cases of dense scarring or ulceration to delimit the minimum area of skin which must be excised before grafting if proper healing is to be obtained. Some factors which might be responsible for the changes seen are tabulated, and an appendix on injection technique and photography is included. (BBB)

19605 THE EFFECT OF BISMUTH 206 IRRADIATION ON SURVIVAL OF SKIN HOMOGRAFTS. C. M. E. Matthews, W. J. Dempster, C. Kapros, and S. Kountz (Ham-

mersmith Hospital, London). Brit. J. Radiol., 37: 306-10 (Apr. 1964).

Subcutaneous injection of ^{206}Bi bound to denatured albumin in one leg of a dog irradiates draining lymph nodes, kidneys, and site of injection, with some whole-body irradiation. This irradiation was found to suppress the accelerated second and third set rejection of skin homografts, whether the grafts drained into irradiated nodes or not. Subcutaneous injection of ^{111}Ag bound to denatured albumin irradiates draining lymph nodes with negligible whole-body radiation. Since after this irradiation the normal accelerated second and third set rejection was present, the effect obtained with ^{206}Bi appears to be due to the effect of the radiation on the whole body, or on some part of the body other than the lymph nodes. (auth)

19606 RADIOSENSITIVITY OF TUMORS, CELL SURVIVAL CURVES, AND TARGET THEORY. T. R. Munro (Strangeways Research Lab., Cambridge, Eng.). Brit. J. Radiol., 37: 310(Apr. 1964).

Research on tumor radiosensitivity applicable to theory is briefly reviewed, and implications for further work are pointed out. (H.M.G.)

19607 STUDIES ON THE CATALASE ACTIVITY OF CHEMOANTIBIOTIC-RESISTANT MYCOBACTERIA SUBJECTED TO X IRRADIATION. F. A. Paolini, F. Moncalvo, and G. C. Moreo (Università, Pavia, Italy). Boll. Soc. Ital. Biol. Sper., 39: 254-7(Mar. 15, 1963). (In Italian)

An earlier study on a strain of Mycobacterium tuberculosis (ATCC-607) resistant to streptomycin (1000 μg/ml) showed that x irradiation with a dose of 60,000 r caused a total loss of catalase activity. Further studies were conducted on five human strains of mycobacteria which were resistant respectively to 100 μg/ml kanamycin, 10 μg/ml isoniazid, 250 μg/ml streptomycin, 250 μg/ml p-aminosalicylate, and 10 μg/ml streptomycin + 25 μg/ml kanamycin. Resistance in these strains was developed in vitro by addition of increasing amounts of these compounds. The cultures were exposed to x-ray doses of 1000 to 80,000 r, and catalase activity was determined by the manganometric method. Irradiation reduced the enzyme activity and doses of 50,000 r in some strains and 60,000 r in others completely abolished activity. The kanamycin- and isoniazid-resistant strains showed greater loss of catalase activity than the other strains. No relation was found between the degree of resistance and enzyme activity or its response to irradiation. (BBB)

19608 PECULIARITIES OF THE HIGHER NERVOUS ACTIVITY OF ANIMALS IRRADIATED IN THE ANTENATAL PERIOD WITH IONIZING RADIATION. REPORT 5. PECULIARITIES OF THE HIGHER NERVOUS ACTIVITY IN EARLY POSTNATAL ONTOGENESIS IN PUPPIES IRRADIATED DURING EMBRYONIC DEVELOPMENT. I. A. Piontkovskii and M. G. Airapetyants (Inst. of Higher Nervous Activity and Neurophysiology, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 22-5(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 1, 26-30(Jan. 1963)).

Conditioned reflex activity was studied during the period of early postnatal ontogenesis by the olfactory and shaking methods in dogs irradiated with x rays on the 45th or the 20th day of embryogenesis in a dose of 200 r. There were 38 puppies under observation: 15 control, 9 irradiated on the 20th day and 14 on the 45th day of embryogenesis. The puppies of experimental litters developed very unevenly (as compared to control) both in somatic respects and in respect to the higher nervous activity. At the age of two months the difference in weight between various experimental puppies constituted about 150%, whereas in control animals it did not exceed 10 to 15%. The connective function of the cerebral cortex in the experimental puppies was deranged right from their birth and up to the age of six months. Conditioned reflexes and especially differentiation in the experimental puppies appear at a later date. Frequent occurrence of phasic conditions (paradoxical, ultraparadoxical) in irradiated animals points to the functional deficiency of cortical cells. In puppies irradiated on the 20th day of embryogenesis the neurodynamic disturbances and especially the processes of cortical inhibition were seen to be more marked than in those irradiated on the 45th day. (auth)

19609 A COMPARATIVE STUDY OF THE DURATION OF MITOSIS AND INTERKINESIS IN MOUSE TISSUES BY MEANS OF COLCHICINE AND IRRADIATION. O. I. Epifanova, A. I. Zosimovskaya, L. Ya. Lomakina, N. V. Grushina, and I. N. Smolenskaya (Inst. of Radiation, Physics, Chemistry, and Biology, Moscow). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 88-91(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 1, 96-100(Jan. 1963)).

A comparative study was performed on the duration of mitosis and interkinesis in the corneal epithelium, uterine epithelium, ear epidermis, and bone marrow of albino mice. The colchicine technique and total irradiation were employed. Shortcomings and advantages of both methods were analyzed. It was shown that for the estimation of mitotic cycles in tissues with a low mitotic activity it is more reasonable to use the colchicine technique, whereas in the tissues with a high proliferative capacity more precise results can be obtained with irradiation. (auth)

19610 DIURNAL PERIODICITY OF MITOSIS IN MICE AFTER IRRADIATION WITH γ-RAYS. L. P. Kosichenko (Inst. of Experimental Pathology and Therapy, Sukhumi USSR). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 106-8(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 1, 114-17(Jan. 1963)).

A study was made of the effect produced by ionizing radiation (190 and 400 r) on the 24-hr periodicity of mitotic activity of the mouse corneal epithelium. As noted, the 24-hr mitotic rhythm was retained on the 5th postirradiation day (doses of 190 and 400 r being used). The time of the maximal (8 A.M.) and the minimal (8 P.M.) number of mitoses in the corneal epithelium of experimental mice coincided with control indices. The difference between the maximal and minimal mitotic activity in the two experiments was highly significant. The range of the 24-hr variations of the number of mitoses showed no significant change in the experimental animals. After irradiation of mice by a dose of 400 r, there was a tendency to a rise of the mean 24-hr intensity of cellular multiplication. (auth)

19611 THE EFFECT OF IONIZING RADIATION ON THE REGENERATIVE PROCESSES RELATED TO BLOOD LETTING. A. D. Strzhizhovskii. Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 148-50(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 2, 37-41(Feb. 1963)).

The effect of radiation on the restorative processes connected with blood letting was studied. An analysis was made of hemoglobin content, number of erythrocytes, and the spectrum of their distribution according to sizes, occurring as a result of combined blood letting and irradiation. As demonstrated, irradiation in a dose of 350 r decreases the amplitude and the duration of the erythropoiesis stimulation peak occurring due to blood letting. The latter procedure done 24 hr before irradiation had a favor-

able effect on the erythropoietic function, but increased the intensity of mature cell disintegration (as compared to the effect of blood letting performed 24 hr after irradiation). The value of the erythropoiesis stimulation peak was largely restored by the 6th day; however, its length was still significantly reduced. (auth)

19612 LOCAL ANESTHESIA IN IRRADIATED ANIMALS. A. V. Lazovskaya (Ministry of Health, Leningrad). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 173-6(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 2, 63-7(Feb. 1963)).

Experiments were conducted on animals subjected to x irradiation. A study was made of the features peculiar to the effect of local anesthetizing agents in various types of anesthesia. As revealed, the effect of decicaine on the cornea of the eye (terminal anesthesia) became intensified during the first hours after the irradiation of the animals (rabbits—1000 r) and reduced by the end of the first 24 hr. The initial value of the effect was restored by the third day. The extent of novocaine block of the sensitive conductors (conduction anesthesia) is greater in irradiated animals (frog—5000 r) than that in nonirradiated ones. The analgesic effect of anesthetics (novocaine, benzocaine, mesocaine) weakened during infiltration anesthesia administered to the irradiated animals (guinea pigs—350 r). (auth)

19613 SOME HISTOLOGICAL CHANGES OF THE SKIN IN HOMOGRAFTS AND IN CORTISONE THERAPY APPLIED TO HEALTHY AND IRRADIATED RABBITS. L. B. Berlin and I. G. Peregudov (Lenin Military Medical Academy, USSR). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 223-6(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 2, 116-20(Feb. 1963)).

The skin of 25 rabbit ears was examined 1 to 42 days after homografts were made and cortisone treatment given. The grafts were made at various stages of acute radiation sickness. Under the influence of cortisone the homograft tissues remained viable for a longer period. The latent period of acute radiation sickness was the most favorable for homografting. At the peak of the disease, regeneration of epithelium and connective tissue are not suppressed, but delayed. (auth)

19614 EFFECT OF ACTIVE AND ULTRAVIOLET-IRRADIATED INACTIVE VACCINIA VIRUS ON THE DEVELOPMENT OF SHAY LEUKEMIA IN RATS. Z. Zakay-Roness and H. Bernkopf (Hebrew Univ., Jerusalem). Cancer Res., 24: 373-8(Apr. 1964).

Intravenous inoculation of large doses of active and uv-irradiated, inactive vaccinia virus caused a lethal effect in rats. Smaller doses which had no apparent ill effect influenced the otherwise always fatal course of tumor development in rats given inoculations of the chloroleukemia of Shay. Both active and inactive virus preparations given 11 days after the inoculation of the leukemic cells prevented the appearance of tumors in a significant percentage of the animals and led to a prolongation of the survival time in others. A destructive effect of active and inactive vaccinia virus preparations on leukemic cells in vitro was also observed. (auth)

19615 CYTOCHEMISTRY OF THE NORMAL AND X-IRRADIATED SPERMATOGENESIS OF STENOBOTHRUS VIRIDULUS (FISCHER). R. S. Mathur (Univ. of Rajasthan, Jaipur, India). Cytologia (Tokyo), 28: 113-17(June 1963).

The chemical constitution of the various cell inclusions of the male germ cells during the process of spermatogenesis and the effects of x irradiation on the chemistry of these inclusions were studied. Owing to the large size of germ cells, these chemical changes could be followed easily. Adult specimens were irradiated with 200 r given over a period of 5.5 min. The testes were fixed at intervals of 72 hr; first visible changes occurred after seven days. The nucleus of the normal sperm cell contains basic proteins, DNA, and acid mucopolysaccharides containing carboxyl groups only. The nuclear membrane, however, shows only the presence of lipids. In the irradiated nucleus, the site of DNA and basic proteins are clearly marked, the former aggregated along the nuclear membrane while the latter concentrated in the center. The mitochondria and the mitochondrial nebenkern of the normal cell consist of tyrosine and arginine. The outer membrane of the nebenkern contains acidic lipids and cholesterol. In the irradiated material, the intensity of the reactions increased with the coagulation of the proteins, but the lipid membrane showed no change. The Golgi bodies consist of galactogen, acid mucopolysaccharides (sulfated type), and acidic lipids. In the irradiated material, the polysaccharides lose the staining power while the lipids form the outer membrane. The acrosome is PAS positive and also contains tyrosine. The latter becomes more pronounced after irradiation. The centriole region consists of lipids plus proteins. The latter coagulate in the irradiated material and are clearly differentiated from the lipids. These observations reveal that the most altered organic compounds after x-ray exposure are polysaccharides and proteins. The former tend to lose the staining power while the latter coagulate. Because of this property of coagulation, the protein components tend to separate from the other compounds. The nucleic acids and lipids, on the other hand, show very little variability in staining. It appears that ionizing radiation has either no effect on them or it is absorbed without causing any visible change in the specificity of their cytochemical reactions. (BBB)

19616 INFLUENCE OF INTRAMUSCULAR FAT LEVEL ON ORGANOLEPTIC, PHYSICAL, AND CHEMICAL CHARACTERISTICS OF IRRADIATED PORK. I. HIGH-TEMPERATURE SHORT-TIME PRE-IRRADIATION HEAT TREATMENT. L. A. Whitehair (Univ. of Wisconsin, Madison), R. W. Bray, K. G. Weckel, G. W. Evans, and F. Heiligman. Food Technol., 18: 108-14(Feb. 1964).

The influence of intramuscular fat (degree of marbling) on characteristics of precooked and irradiated pork muscle was studied. Loins were selected and categorized into three marbling levels by visual appraisal. A relatively high temperature (325°F) and short time (2 hr) heat treatment was used for enzyme inactivation. Samples were packed under vacuum in rigid containers and irradiated to 4.5 Mrad with γ radiation. Irradiated and frozen control samples were evaluated up to 210 days later. Degree of marbling had no apparent influence on organoleptic properties of either irradiated or frozen control longissimus dorsi muscle samples. Frozen control samples were preferred in general appearance, flavor, and over-all acceptability by panelists. Irradiated samples were preferred in texture qualities. Storage time was not a major factor in organoleptic acceptability; however, acceptability of irradiated samples declined between 150 and 210 days of storage. Hunter color attributes were not affected by marbling level. $\underline{L}$, $\underline{a}_{\underline{L}}$ hue, and saturation were increased by radiation treatment. Mechanical tenderness values were decreased due to higher marbling level and radiation treatment. Expressible-moisture values were lowered by radiation treatment and increased with storage time. Iodine numbers were decreased by radiation. Degree of marbling did not affect thiobarbituric acid values but they were signifi-

cantly lower for irradiated samples. pH values increased with higher levels of intramuscular fat, were significantly higher in irradiated samples than controls, and tended to increase steadily with advancing storage time. (BBB)

19617 INFLUENCE OF INTRAMUSCULAR FAT LEVEL ON ORGANOLEPTIC, PHYSICAL, AND CHEMICAL CHARACTERISTICS OF IRRADIATED PORK. II. LOW-TEMPERATURE LONG-TIME PRE-IRRADIATION HEAT TREATMENT. L. A. Whitehair (Univ. of Wisconsin, Madison), R. W. Bray, K. G. Weckel, G. W. Evans, and F. Heiligman. Food Technol., 18: 114-19(Feb. 1964).

Pork muscle (longissimus dorsi) was graded in three marbling levels by both visual appraisal and ether-extraction analysis of total fat. A low-temperature (121°F, gradually increasing to 191°F), long-time (19-hr) heat treatment was used for enzyme inactivation. Samples were packed under vacuum in rigid containers and irradiated to 4.5 Mrad with γ radiation. Irradiated and frozen control samples were evaluated at intervals over a 180-day period. The heat treatment caused excessive connective-tissue breakdown as evidenced by a soft, dry texture. Marbling level had no significant effect on consumer-panel judgments of irradiated or frozen control samples (served plain, without bread). Lower degrees of marbling were preferred in irradiated sandwich items. Irradiated samples were less preferred than frozen control samples in both plain and sandwich form. Hunter L (color) values, a_L (redness), hue, and saturation attributes were increased by irradiation treatment. Hunter L and b_L (yellowness) values of highly marbled irradiated samples were elevated. Highly marbled samples displayed greater tenderness qualities, as evidenced by mechanical tenderness measurements. Expressible moisture values were decreased by marbling degree and radiation treatment and increased by advancing storage time. As a measure of oxidation rancidity, thiobarbituric acid values were increased by increasing levels of marbling and advancing storage time, but were not influenced by preservation method. No significant differences in pH values due to marbling level or preservation method were detected. Bacteriologic counts of randomly selected irradiated samples indicated that they were commercially sterile (average of 57 colonies/g of sample). Methylene blue stains of colonies revealed Micrococcus. Frozen (control) samples contained moderate numbers of colonies (av. 2300 colonies per g of sample). Micrococcus colonies were again predominant, but a few colonies of film yeasts were also seen. Irradiated samples were negative for thermophilic anaerobic spores producing gas. Control samples were positive, containing gram-negative rods, Escherichia coli, and gram-positive cocci. (BBB)

19618 GENETIC CONTROL OF PATTERN DETERMINATION IN DROSOPHILA. THE ACTION OF HAIRY-WING. Frederick Jay Gottlieb (Univ. of California, Berkeley and Univ. of Pittsburgh). Genetics, 49: 739-60(May 1964).

A developmental analysis of the differences in differentiation in tissues of the Hairy-wing (Hw) homozygous, heterozygous and Hw^+ homozygous genotypes was performed utilizing genetic mosaics produced by x-ray-induced crossing over in heterozygous larvae. The mosaics and controls were characterized by a series of measurements and counts in the dorsocentral region. Interactions were observed between the three different genotypes in mosaics. Hw/Hw tissue acts semiautonomously in mosaics, having an expression, in the dorsocentral region, 0.64 that of the homozygote controls. Hw^+/Hw^+ tissue acts nonautonomously and will occasionally produce extra macrochaetae in the presence of adjacent Hw/Hw tissue. X irradiation causes Hw heterozygotes to express themselves in a homozygous-like fashion. Making Hw/Hw and Hw^+/Hw^+ coisogenic for their second and third chromosomes, while it effects the linear dimensions, does not alter the numbers of chaetae. The evidence suggests that Hw alters both the prepattern and the competence of the differentiating hypodermal cells. (auth)

19619 A LOCUS FOR RADIATION RESISTANCE IN ESCHERICHIA COLI. Joseph Greenberg (Palo Alto Medical Research Foundation, Calif.). Genetics, 49: 771-8(May 1964).

Radiation resistance was transferred by genetic recombination from Escherichia coli strain K-12 radioresistant donors to strain B radiosensitive recipients. The locus for radioresistance in K-12 is closely linked to the locus for resistance to phage T6. Resistance to the radiomimetic agent 1-methyl-3-nitro-1-nitrosoguanidine is transferred concomitantly with resistance to ultraviolet radiation. (auth)

19620 EFFECTS ON GENETIC RECOMBINATION OF ESCHERICHIA COLI K-12 PRODUCED BY X-RAY AND ALPHA-PARTICLE IRRADIATION OF THE FEMALE. T. H. Wood and H. Marcovich (Institut Pasteur, Paris). Genetics, 49: 779-86(May 1964).

In genetic recombination involving crosses between Escherichia coli K-12 donors (HfrH) and recipients (PA-309), the effects of x-ray or α irradiation of the recipient before mating were studied. The radiosensitivity for the appearance of a selected male marker in a recombinant cell is inversely related to the distance between the origin of the male chromosome and the position of the marker. Also, the linkage between male markers in the recombinants increases with dose received by the female. These results suggest that a selective advantage is conferred on those recombinants which receive larger portions of the male chromosome during mating and that at high dose levels where the female chromosome may be badly damaged, recombinants receive their genetic information almost entirely from the male chromosome. The results can be easily interpreted by a Copy-Choice mechanism for genetic integration in which radiation lesions act as switching sites, but are not inconsistent with a Break-and-Reunion model in which linkage between lethal radiation lesions on the female chromosome and the female characters provides a bias in favor of male inheritance. (auth)

19621 NEUROSPORA MUTANTS LACKING ORNITHINE TRANSCARBAMYLASE. V. M. Woodward and Patricia Schwarz (Rice Univ., Houston, Tex.). Genetics, 49: 845-53 (May 1964).

Mutants lacking ornithine transcarbamylase, the enzyme which couples ornithine to carbamyl phosphate, were isolated by two methods: as suppressors of the class of pyr-3 mutants displaying in vitro aspartic transcarbamylase activity, and by the filtration and selective plating technic, using conidia of a suppressor mutation, s. This strain suppresses, among other mutants, the class of pyr-3 mutants referred to above. The enzymatic phenotypes of these mutants are described and, although infertility makes it difficult to prove allelism, genetic analyses indicate that all of the mutants studied are located near arg-5 on linkage group II. (auth)

19622 INFLUENCE OF OXYGEN, HELIUM, AND METABOLIC INHIBITION ON X-RAY INDUCED DOMINANT LETHALITY IN STAGE 7 AND STAGE 14 OOCYTES OF DROSOPHILA MELANOGASTER. Robert R. Rinehart

(Oak Ridge National Lab., Tenn.). Genetics, 49: 855-63 (May 1964).

Experiments designed to test the effects of various oxygen tensions given before, during, and after the x irradiation of adult females on the survival of Stage 7 and Stage 14 oocytes support the conclusion that no significant differences in the relative radiosensitivity between Stage 7 and Stage 14 oocytes is attributable to differential amounts of intracellular oxygen. Extended helium pre- or posttreatment causes a significant increase in x-ray-induced dominant lethality in Stage 7 oocytes. This increase in lethality is proportional to the duration of anoxia. No such sensitizing effect of helium treatment is observed with the Stage 14 cells. The effect of anoxia in increasing dominant lethality is prevented when the flies are given anoxic treatments at 4°C. The effects of anoxic pretreatment are reversed when the cells are allowed to recover in air prior to irradiation. The results are interpretable in terms of a system that repairs chromosome breaks and that is depleted during prolonged anoxia. (auth)

19623 STUDIES ON THE IMMUNE RESPONSES OF CONTINUOUSLY IRRADIATED MICE. J. P. M. Bensted (Royal Cancer Hospital, London). Guy's Hosp. Rept., 112: 375-91(1963).

The construction and use of a chamber for exposing mice continuously to ^{137}Cs γ radiation is described and illustrated. The continuous irradiation unit consists essentially of a 7-C central source of ^{137}Cs around which the animals are arranged in cages at varying distances from the source so that the dose rate depends on the distance of the animal from the source. As a measure of the effect of radiation on the immune status of mice, their ability to produce hemagglutinating antibody as a primary response to sheep red cells was measured at various times after exposure to continuous γ radiation. In the first study the ability of preimmunized mice to produce hemagglutinating antibody while exposed to continuous radiation at a dose rate of 84 r/day for 27 days was examined. Despite large accumulated radiation doses (2350 rad), the hemagglutinin titers were well maintained and even enhanced, particularly on removal from the unit. Mice exposed to continuous radiation at 50 r/day for varying periods prior to immunization were able to produce appreciable amounts of antibody but at lower levels than in the controls. The pattern of response indicated a delay in reaching control values rather than a diminution in titers. From histologic observations, it is suggested that the large amounts of sequestrated iron present in the spleen following irradiation may play an important part in stimulating the reticuloendothelial system (RES) to produce antibody in increased amounts. This iron accumulates mainly as a result of destruction and sequestration of circulating red cells, and it could be acting in the same way as a carbon suspension has been previously been shown to induce the transformation of the lymphoid cells into the radioresistant plasma cells. After removal from the ^{137}Cs unit, the amount of iron in the spleen diminished as a result of the reutilization of the iron by the actively regenerating red cell system. Despite this, the number of plasma cells increased as a result of further mitotic activity of the plasmablasts and plasma cells. The presence of large numbers of mast cells in the spleens of mice during the early part of radiation exposure was noted. The mast cell increase following irradiation may thus result in higher local levels of heparin, and these levels may in turn increase the tendency to local hemorrhage with further deposition of iron in the macrophages of the red pulp. It is concluded that the increased antibody levels are a reflection of the proliferation of some cell type of the RES which remains relatively resistant despite the accumulation of large doses of radiation. (BBB)

19624 CYTOLOGICAL CHANGES IN ORAL LEUKOPLAKIA BEFORE AND AFTER DEEP X-RAY IRRADIATION. K. S. Rijhsinghani and K. Sundaram (Atomic Energy Establishment, Trombay, India). Indian J. Med. Sci., 16: 55-8(June 1962).

The relative frequency of the different types of cells seen in various stages of leukoplakia and the cellular changes induced by fractionated doses of deep x irradiation were studied in 104 patients. All these cases received intraoral treatment with a 55-kv machine with 0.5-mm Cu and 1.0-mm Al filtration; 400 r was administered to the diseased area of the cheek or tongue six days a week to give a total dose of 3600–4000 r. Cytologically, pretreatment smears could be classified into the following 3 types: Type I (predominantly acidophilic squamous cells with pyknotic nuclei, groups of hyperkeratinized cells with no visible nuclei, and squamous cells with perinuclear vacuoles and cytoplasmic granules; Type II (squamous cells with moderate variation in nuclear shape, size, and staining quality; nuclei contained one or two small nucleoli, and superficial squamous cells with acidophilic cytoplasm and pyknotic nuclei with perinuclear vacuoles were also present; Type III (cells had acidophilic cytoplasm and cell limits were ill defined; nuclei showed anisonucleosis, hyperchromatism and presence of distinct nucleoli). The radioinduced changes varied in three different types of smears. Lesions which were characterized by Type I smears manifested mild alteration in cell morphology during the course of irradiation. Acidophilic and basophilic squamous cells were moderately enlarged in size but the shape, size, and staining affinity of the nuclei did not change. Cytoplasmic vacuoles were evident. A constant findings was a great increase in the number of cells with cytoplasmic granules. Occasional cells showed the presence of two nuclei, especially after a total dose of 2000 r. At the end of treatment (after a total dose of 3600 to 4000 r) the cell picture remained the same. The radioinduced changes in the Type II lesions exhibited some alterations similar to those described in Type I; however, a difference in the intensity of reaction was evident. Cells with marked variation in nuclear size and with distinct nucleoli were prominent, and an increase in the number of binucleated and multinucleated squamous cells was also observed. These changes became evident after a dose of 1200 to 1600 r and a few enlarged cells persisted until the end of the treatment. The cytologic response to radiation of Type III lesions was seen as sheets of cells with ill-defined cell boundaries and opaque cytoplasm. Their nuclei showed marked enlargment, thick nuclear membranes, chromatin clumping, and prominent nucleoli. Occasionally bizarre cells and multinucleated cells were seen. These smears also contained degenerated cells, leukocytes and histocytes. These changes were noted after 1200 to 1600 r and were pronounced following 2400 to 2800 r. With progressive irradiation the nuclei showed various types of degeneration, such as pyknosis and karyolysis. The different types of response elicited were explained as follows: the predominant cells seen in Type I and II are precornified and cornified superficial squamous cells while the cells from the deeper layers, viz. the parabasal and intermediate cells, are generally absent in Type I and rare in Type II. Hence, the following irradiation, morphological alterations would be observed in the superficial squamous cells only and the nature of the changes induced in the parabasal and intermediate cells cannot be assessed as they do not appear in the smears of these two types of leukoplakia. In lesions with a Type III

smear the parabasal and intermediate cells with atypical nuclei predominant and the alterations produced by irradiation in the cells become manifest. The presence of persistence of cells with atypical nuclei during treatment could be regarded as a sign of unfavorable response to irradiation therapy. Apparently some of these lesions with Type III smears are premalignant conditions and may in the course of time become malignant. (BBB)

19625 RADIATIONS, RADIOLOGISTS, AND THE HUMAN RACE. B. W. Windeyer (Middlesex Medical School, London). Indian J. Radiol., 15: 45-55(May 1961).

Recent advances in radiodiagnosis, radiotherapy, and radiobiological research are reviewed with reference to unanswered questions concerning the possible detrimental effects of low-level radiation exposure on human populations. Immediate and urgent reasons for the intensification of radiobiological research, to give a sound foundation on measures for the maintenance of radiological health and safety, are cited. Evidence of the leukemogenic and cancerogenic effects of radiation in humans is surveyed. It is concluded that relatively large doses of radiation, given in a short time, can cause an increase in the incidence of leukemia and of cancer, but it is not known whether such dosage, spread over a long time, will also cause such increased incidence, and still less is it known if much smaller doses, given over long periods of time, will have any harmful effect. It is suggested that, while occupational exposure can be related to the ordinary risks of civilized industrial life, the protection of the population as a whole from damage from radiologic exposure must be made as absolute as possible, and that new causes of possible environmental hazard are developing, such as those associated with radioactive effluent, disposal of radioactive wastes, and reactor accidents. Other topics considered include the assessment of radiation hazards to patients, a critique of the Adrian report, and the organization of a medical school radiochemical department. (BBB)

19626 RELATIONSHIP BETWEEN THE DOSE OF WHOLE-BODY X-IRRADIATION AND THE URINARY EXCRETION OF 5-HYDROXYINDOLEACETIC ACID IN RATS. Ž. Deanović, Ž. Supek, and M. Randić (Institut "Rudjer Boskovic," Zagreb). Intern. J. Radiation Biol., 7: 1-9 (July 1963).

The dependency on x irradiation dose of urinary excretion of 5-hydroxyindoleacetic acid (5-HIAA) in rats was studied. A significant positive correlation between the applied doses: 50, 100, 150, 200, 400, 600, and 800 r, and 5-HIAA excretion-rate was found. By means of this biochemical test it is possible to discriminate between animals irradiated with low (50, 100, 150 r), medium (200, 400 r) and high (600, 800 r) doses. The maximal increase of 5-HIAA output after irradiation appeared during the first 24 hours; excretion returned to normal values on the third day after irradiation. The females showed a more pronounced response to radiation than the males. The dose of 200 r seemed to be the lowest that significantly increases the output of 5-HIAA. The rats pretreated with sub-lethal doses (50–200 r) responded to the subsequent dose of 800 r with somewhat delayed reaction. Some other urinary substances showing a certain irradiation dose-dependency were compared with 5-HIAA; the latter appears to be a good indicator for the evaluation of absorbed radiation dose. (auth)

19627 THE EFFECT OF IONIZING RADIATION ON A MARINE PSEUDOMONAS sp. I. EFFECTS OF IRRADIATED LIQUID GLUCOSE-SALT MEDIUM ON POPULATIONS IN EXPONENTIAL-GROWTH PHASE. Erik von Sydow and Jaan Tear (Swedish Inst. for Food Preservation Research (SIK), Goteborg). Intern. J. Radiation Biol., 7: 11-19(July 1963).

The effects of ionizing radiation on a marine Pseudomonas sp. has been tested under different experimental conditions: unirradiated cells inoculated into irradiated media; irradiated cells plated immediately after irradiation; and irradiated cells incubated in irradiated media. Irradiated liquid synthetic medium was found to have a bactericidal effect on a radiosensitive marine Pseudomonas sp. taken from exponentially growing cultures. The indirect toxic effects of the irradiated media were, however, relatively small compared with the total effect of direct irradiation of the organisms in suspensions. The indirect toxic effects of the medium were found to decrease slowly with time. They were assumed to be due mainly to the combination of glucose and ammonium chloride in the medium. The turbidimetric method used was found to be time-saving and gave accurate results. It can thus be recommended for similar investigations. (auth)

19628 THE EFFECT OF IONIZING RADIATION ON A MARINE PSEUDOMONAS sp. II. THE TOTAL EFFECTS ON POPULATIONS IN DIFFERENT GROWTH-PHASES. Jaan Tear (Swedish Inst. for Food Preservation Research (SIK), Göteborg). Intern. J. Radiation Biol., 7: 21-8(July 1963).

Inactivation of Pseudomonas sp. No. 128 was found to be independent of concentration up to a critical level of 2×10^8 org/ml. The highest sensitivity was noted in the exponentially-growing cultures, and the highest resistance in cultures in the negative accelerating growth-period (0.5 and 50.0% survival, respectively, for 10.0 krad established immediately after irradiation). Resistance was essentially the same during lag and late declining periods (1.0% survival for the standard dose used). Exponentially growing cultures showed a continuously increasing inactivation on delay of the plating after irradiation (from 0.5 to 0.005% survival at 10.0 krad). No such effects were noted for cultures in late declining or maximum stationary growth-periods. Survival-curves for samples taken from maximum stationary and declining growth-periods were exponential. A cumulative type of survival-curve was noted for organisms from the lag and logarithmic periods of growth. (auth)

19629 THE EFFECT OF ELECTRON RADIATION ON THE TENSILE STRENGTH OF TENDON. [PART] II. Reinier Braams (Universiteit, Utrecht). Intern. J. Radiation Biol., 7: 29-39(July 1963).

Strips of cow achilles-tendon were irradiated with 1 Mev electrons. Various pre- and post-treatments were applied, such as drying and hydration, tanning, and addition of cysteine. On dry and hydrated fibers measurements of tensile strength and modulus of elasticity were performed. On hydrated fibers the shrinkage temperature was measured. The results indicate that radiation causes main chain scission in the collagen molecule. The wet-irradiated fiber has a smaller radiation sensitivity than the dry-irradiated fiber, when measured in the hydrated state. This can be explained through the formation of cross-links by a radical reaction between chains that can move more freely in the hydrated state. If cysteine is present in the hydrated fiber during irradiation, the radiosensitivity increases again and returns to the original level. Being a radical scavenger cysteine probably prevents the formation of cross-links and in this way impairs a mechanism that can counteract radiation damage. Drying of the irradiated fiber, especially under tension, partly restitutes order and leads to a 37%

dose about ten times as high as for the hydrated fiber. The broken covalent bonds, however, are not restored and therefore the repair is not permanent: hydration is sufficient for the radiation damage to manifest itself. If the Platzman-Franck mechanism should be operative to an appreciable extent, some degree of permanent repair is to be expected from drying the irradiated fiber under tension. (auth)

19630 THE EFFECT OF LOW RADIATION DOSES ON THE RELEASE OF DEOXYRIBOPOLYNUCLEOTIDES IN HAEMATOPOIETIC AND LYMPHATIC TISSUES. M. Skalka and J. Matyasova (Inst. of Biophysics, Brno). Intern. J. Radiation Biol., 7: 41-4(July 1963).

After irradiation, the amount of deoxyribopolynucleotides, substances soluble in 0.14 M solution of sodium chloride, insoluble in 0.2 M solution of perchloric acid and giving a positive reaction for deoxyribose with diphenylamine, increases in hematopoietic and lymphatic tissues of mice and rats. It was found that the increase is practically a linear function of the radiation dose ranging within 0–300 r. With the aid of this reaction, irradiation with a dose of 30–50 r, or contamination due to intraperitoneal administration of 5mC ^{32}P/kg body-weight, can be diagnosed. It is believed that the determination of the level of deoxyribopolynucleotides could be used as an early indicator of acute radiation lesions due to small and medium radiation doses. (auth)

19631 STUDIES ON DETOXICATION BY THE PERFUSED LIVER. I. HIPPURIC ACID SYNTHESIS AFTER IRRADIATION. G. B. Gerber and J. Remy-Defraigne (CEN, Mol, Belg.). Intern. J. Radiation Biol., 7: 53-7 (July 1963).

Synthesis of hippuric acid was determined in the isolated perfused liver of normal and x irradiated rats with and without addition of glycine. An increase in synthesis of hippuric acid without addition of glycine was found in x irradiated liver, indicating an expansion of the free glycine pool. On the other hand, synthesis of hippuric acid in x irradiated liver was found to be slightly decreased when large amounts of glycine were present in the perfusate. (auth)

19632 STUDIES ON DETOXICATION BY THE PERFUSED LIVER. II. BILIRUBIN CONJUGATION AND EXCRETION AFTER IRRADIATION. G. B. Gerber and J. Remy-Defraigne (CEN, Mol, Belg.). Intern. J. Radiation Biol., 7: 59-64(July 1963).

Formation of conjugated bilirubin and its excretion into the bile was studied in the isolated perfused liver of normal and x irradiated rats. Bilirubin is removed rapidly from the blood and is excreted, after a lag-period, to about 70–85% as conjugated bilirubin into the bile. Conjugation occurs mainly with glucuronic acid but also with other compounds. Removal of bilirubin from the blood and excretion of conjugated bilirubin in the bile are delayed in the perfused liver of x irradiated rats. (auth)

19633 ENERGY DISSIPATION OF TRITIUM IN MICRO-ORGANISMS. Sonia Apelgot and Maurice Duquesne (Faculté des Sciences, Paris). Intern. J. Radiation Biol., 7: 65-74 (July 1963). (In French)

Determination of the amount of energy lost by tritium uniformly distributed in spheres of water or DNA (of radius between 0.015 and 10 μ) was carried out and the corresponding curves were drawn. The results were used in the analysis of results of various experiments on the inactivation of bacteria or T2 bacteriophage labeled with ^{3}H-thymidine. (auth)

19634 EXPERIMENTS IN RADIATION CHEMISTRY OF T1-PHAGE. G. Hotz and K. G. Zimmer (Kernforschungszentrum, Karlsruhe, Ger.). Intern. J. Radiation Biol., 7: 75-86(July 1963).

The addition of sulfhydril-compounds, freeze-drying, and low temperature reduces inactivation by ionizing radiation of plaque-forming ability in T1-phage by various and nearly additive amounts: if combined these changes of circumambient conditions during irradiation lead to factors of protection of p = 16 (as compared to irradiation in highly concentrated broth). The results fit a model of radiation effects as proposed by others after its extension to provide for the effects of low temperature. Existing physico-chemical evidence in support of the model is discussed briefly. Replacing some of the thymine in the DNA of T1 by 5-bromouracil leads to a sensitization of inactivation by ionizing radiation, which neither depends on nor changes the efficiency of the protective measures mentioned above with one exception: when irradiation is done in sulfhydril-containing broth sensitization by 5-bromouracil vanishes completely. (auth)

19635 STEM-CELL KINETICS AFTER IRRADIATION. R. Alexanian, D. D. Porteous, and L. G. Lajtha (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Intern. J. Radiation Biol., 7: 87-94(July 1963).

The response of stem cells to irradiation was studied in polycythemic and normal mice. The sensitivity of stem-cell reproductive integrity to irradiation was found to have a D_0 of approximately 65 rads. After a dose of 150 rads, stem-cell response to erythropoietin recovered to normal by the seventh day, and exceeded control values by a factor of two by the 12th day. Increased stem-cell integrity at this time was associated with a normal blood hematocrit, a twice normal reticulocyte percentage, a higher red-cell utilization of radio-iron, and a greater resistance to lethal irradiation. (auth)

19636 THE FASTED MOUSE IN THE STUDY OF BONE-MARROW STEM-CELL KINETICS. D. D. Porteous, R. Alexanian, and L. G. Lajtha (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Intern. J. Radiation Biol., 7: 95-100(July 1963).

A method for the study of bone-marrow stem-cell kinetics, using fasting to depress erythropoiesis, with its reinstatement when feeding is restarted, is described. The effect of radiation on this system was compared with that revealed by other methods of exploring stem-cell behavior. The dose-response relationship, with a D_0 of 60 rads, and the observation of a stem-cell overshoot at 12 days after 150 rads, were similar to those recorded when other procedures were used. (auth)

19637 RESTORATION OF SUPRALETHALLY IRRADIATED AMOEBAE. John Read (Wakari Public Hospital, Dunedin, N. Z.). Intern. J. Radiation Biol., 7: 101-2(July 1963).

The restoration of supralethally irradiated amoebae by dispersed nuclear material present in the amoebae is discussed. (P.C.H.)

19638 OBSERVATIONS ON AMINO-ACID EXCRETION IN ACCIDENTALLY-IRRADIATED HUMANS. Frank M. Ganis and Joe W. Howland (Univ. of Rochester, N. Y.). Intern. J. Radiation Biol., 7: 107-8(July 1963).

Results of twenty-four-hour urine samples collected from individuals exposed to low-level gamma and neutron radiation for a period of 15 days after exposure and analyzed for amino acid content are discussed. Among the amino acids identified were cystine, histidine, alanine, serine, glycine, glutamic acid, and leucine. All were excreted within the normal range; thus it was concluded that the radiation exposure did not significantly alter the quan-

titative output of the observed amino acids in the individuals. Other accident subjects were also studied. The results were in agreement with the generally accepted view that exposure to ionizing radiation may give rise to a variable aminoaciduria. (P.C.H.)

19639 EFFECT OF CHEMOPROTECTION BY CYSTAMINE ON URINARY EXCRETION OF 5-HYDROXYINDOLEACETIC ACID IN X-IRRADIATED RATS. Z. Deanovic, Z. Supek, and M. Bulat (Institut "Rudjer Boskovic," Zagreb). Intern. J. Radiation Biol., 7: 109-11(July 1963).

Studies were made on the excretion of 5-HIAA in the urine of lethally irradiated rats protected with a chemoprotector that is not a 5-hydroxyindole. It was concluded that cystamine produces inhibition of the post-irradiation increase in urinary excretion of 5-HIAA in rats but that inhibition is incomplete. Three possible explanations are given: cystamine prevents the discharge of 5-HT from body depots; it deviates the metabolic pathway of 5-HT; or inhibits the renal tubular secretion of 5-HIAA. (P.C.H.)

19640 EFFECT OF X-IRRADIATION ON THE CIRCULATORY SYSTEM OF THE HIND LIMB OF THE MOUSE. Alice Sams (Westminster Hospital, London). Intern. J. Radiation Biol., 7: 113-29(Aug. 1963).

The effects of 2000 r of x rays on the vascular system of the left hind limbs of 3- and 12-week-old mice are described. Arteriograms show a reduction in the efficiency of the larger irradiated vessels in conducting blood during the period 13 to 87 weeks after irradiation. The degree of impairment of function varied, and in some cases was sufficient to cause severe ischemia with subsequent necrosis of the lower part of the limb. It is suggested that radioinduced fibrosis of the surrounding tissues causes loss of efficiency in the larger vessels at least by exerting pressure on them. The resultant reduction in flow could lead to further loss of efficiency owing to proliferation of the intima and further reduction in the size of the lumen. Some confirmation of this has been observed histologically. (auth)

19641 THE EFFECT OF X-IRRADIATION ON THE DEGRADATION OF DNA IN CLOSELY-RELATED STRAINS OF E. COLI. B. Miletić, Ž. Kućan and Lj. Šašel (Institut "Rudjer Bošković," Zagreb). Intern. J. Radiation Biol., 7: 141-4(Aug. 1963).

Degradation of DNA caused by x irradiation was studied in E. coli B and in two closely related radioresistant strains. After the same dose of radiation, the degradation was different in the three strains, being the highest in one of the radioresistant strains. (auth)

19642 PROGRESSIVE ALTERATION OF SERUM PROTEINS IN RATS SEVERAL MONTHS AFTER AN ACUTE OR PROTRACTED IRRADIATION. A. Reuter and Roger Chys (Universite, Laval, Que.). Intern. J. Radiation Biol., 7: 197-200 (Aug. 1963).

Sprague-Dawley rats six- to eight-weeks-old were given ^{60}Co gamma irradiation in doses ranging from immediately sublethal to the LD^{50}. One group of animals kept at 6°C for one month prior to irradiation was able to survive whole-body doses up to 1800 rads. Microdetermination of total serum proteins made in normal and irradiated rats by the Biuret method yielded no significant variations in the total serum proteins of any one group. However, the γ-globulin fraction increased markedly in most irradiated rats. Cold acclimatization did not make significant alterations in the serum-protein pattern of irradiated rats, and no relation between magnitude of radiation dose and protein changes was observed in the dose-range used. (H.M.G.)

19643 A METHOD OF BIOLOGICAL DOSIMETRY IN MAMMALS. I. M. Shapiro and N. F. Barakina (Inst. of Animal Morphology, Academy of Sciences, USSR). Intern, J. Radiation Biol., 7: 213-19(Sept. 1963).

The data presented show that, by the percentage of cells with chromosomal aberrations, it is possible to establish which parts of the body were irradiated and to evaluate the radiation dose. Biological dosimetry may be performed within the dose range up to 700 to 1000 r on the first and second days (on bone marrow cells of mice) and on the sixth and seventh days (on skin epithelium) after x irradiation. (auth)

19644 SURVIVAL KINETICS OF HeLa S-3 CELLS AFTER INCORPORATION OF ^{3}H-THYMIDINE OR ^{3}H-URIDINE. G. Marin and M. A. Bender (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 7: 221-33(Sept. 1963).

The survival kinetics of mammalian tissue culture cells containing tritium-labeled nucleosides were studied. HeLa S-3 cells were allowed to incorporate various amounts of ^{3}H-thymidine or ^{3}H-uridine into their DNA or RNA. Owing to the short mean free path of the tritium-decay β-ray, incorporation of ^{3}H-thymidine irradiates mainly the nucleus, while most of the radiation from the ^{3}H-uridine is absorbed by the cytoplasm. A model which takes into account the persistence of β radiation from the labeled nucleic acids and the dose rate reduction due to cell division was constructed for the expected survival kinetics. The experimental data were fitted to this model by means of a digital computer. It was found that the hit number was not significantly different from the values previously reported for x rays. It was concluded that all the cell killing seen can be accounted for by the β radiation to which the cell is exposed. (auth)

19645 A COMPARISON OF MAMMALIAN CELL-KILLING BY INCORPORATED ^{3}H-THYMIDINE AND ^{3}H-URIDINE. G. Marin and M. A. Bender (Oak Ridge National Lab., Tenn.). Intern. J. Radiation Biol., 7: 235-44(Sept. 1963).

The fact that the β radiation from ^{3}H atoms incorporated into cellular DNA is absorbed largely in the nucleus, while more of that from ^{3}H incorporated into RNA is absorbed in the cytoplasm than in the nucleus, provides a means of determining the relative importance of nuclear and cytoplasmic damage in radioinduced mammalian cell death. Synchronously dividing populations of Chinese hamster fibroblasts were pulse-labeled with various doses of either ^{3}H-thymidine or ^{3}H-uridine. The labeled cells were plated, and survival curves obtained. Autoradiographic silver grain counts and liquid scintillation counting were used to measure the nuclear β radiation doses. It was found that the slope of the ^{3}H-uridine survival curve was somewhat greater than that of the ^{3}H-thymidine curve. Since the β-radiation dose to the cytoplasm was larger than that to the nucleus, however, it is concluded that the contribution of cytoplasmic damage to radioinduced reproductive death of mammalian cells is very small. (auth)

19646 DOSE-RATE AND THE INDUCTION OF MUTATION IN DROSOPHILA. C. E. Purdom and T. W. McSheehy (Medical Research Council, Harwell, Berks, Eng.). Intern. J. Radiation Biol., 7: 265-75(Sept. 1963).

Drosophila male germ cells were exposed to 800 rad of ^{60}Co γ rays at three different dose rates, 0.05, 0.5, and 5.0 rad/min. F_0 males were mated in seven successive broods of which broods I and VII were sampled for IInd chromosome recessive lethal mutations. Mutation frequency was independent of dose rate in each brood. It was

concluded that dose-rate had no discernible effect on induced mutation frequency in spermatids (brood I) or spermatogonia (brood VII). Results are discussed in relation to the hypothesis that the dose-rate effect discovered by Russel in the mouse arose through repair of genetic radiation damage. It is suggested that killing of cells by radiation, which is much more extensive in the mouse than in Drosophila, would be a more plausible mechanism to explain the dose-rate effect than repair, for which there is no corroborative evidence. (auth)

19647 THE GENETICAL RESPONSE OF DROSOPHILA SPERMATOZOA TO DIFFERENT TYPES OF RADIATION TREATMENT. O. S. Reddi (Osmania Univ., Hyderabad, India). Intern. J. Radiation Biol., 7: 301-5(Sept. 1963).

Drosophila spermatozoa were exposed to x rays in air, x rays in nitrogen, and neutrons in air. Each treatment was given either to males or inseminated females. After x irradiation in air the frequencies of sex-linked lethals and translocations were highest among the progeny of treated inseminated females, lower in the first-day progeny of treated males, and lowest in the second-day progeny of treated males. After x irradiation in nitrogen or after neutron radiation, all three frequencies were the same. This suggests that both differences (male vs female treatment; first vs second day) have the same basic cause. Experiments in which x-rayed males were mated after one or two days of storage without females indicate that this cause is differential radiosensitivity between fully and nearly mature spermatozoa. (auth)

19648 RECOVERY OF MALE FERTILITY AFTER STERILIZATION BY NUCLEAR RADIATION. John MacLeod (Cornell Univ., Ithaca, N. Y.), Robert S. Hotchkiss, and Beecher W. Sitterson. J. Am. Med. Assoc., 187: 637-41(Feb. 29, 1964).

The potential fertility, in terms of semen quality of eight men was investigated 3½ years after they were exposed accidentally to ionizing radiation of nuclear origin. It was established that at least five of these individuals received sufficient total-body radiation (236 to 365 rads) to produce symptoms of acute radiation syndrome and that at least five had been found to be virtually sterile within four months after the accident. As determined at intervals by semen quality, a virtually sterile state was maintained for at least 21 months. Disturbances in morphology of the few spermatozoa present in the ejaculate were observed this time. A reasonable to good level of potential fertility was attained at 41 months after exposure. (auth)

19649 ON THE STRUCTURES DIFFERENTIATED FROM X-IRRADIATED AMPHIBIAN ECTODERM. M. Reyss-Brion (College de France, Paris). J. Embryol. Exptl. Morphol., 11: 649-57(Dec. 1963). (In French)

Temporal aspects of reactivity to inductors and teratogenic effects of x radiation in ectodermal structures were investigated by exposure of amphibian gastrulas to doses of 150 to 1050 r. The ectoderm of the young gastrula of Pleurodeles and of Axolotl loses the capacity to form neural structures after x irradiation. With increasing doses, the order in which structures fail to form in hindbrain, forebrain, and spinocaudal structures. The hindbrain is not formed after irradiation by 300 and 550 r, although the forebrain survives after 550 r and sometimes after 800 r. It is, however, much reduced in size. After such high doses of x rays, spinocaudal formations are present in almost 100% of cases, but they also are missing after doses of 1050 r. In contrast to the findings using progressively more denatured inductors, it is the brain structures which disappear first when the competent tissue is injured. (BBB)

19650 POSSIBLE INTERPRETATION OF THE MUTAGENIC EFFECT OF ULTRAVIOLET RADIATION. J. Ladik (Central Research Inst. for Chemistry, Budapest). J. Theoret. Biol., 6: 201-7(Mar. 1964).

The π electron densities in the ground states and in several excited states of the nucleotide base pairs were investigated in the Hückel approximation, from the point of view of the recent double proton tunneling mutation mechanism proposed by Löwdin. It was found that in the case of the G–C base pair one excitation having a large probability produces changes in the π electron distribution, which makes the G–C → G*–C* simultaneous tautomeric rearrangement more probable, thus giving a possible interpretation of the mutagenic effect of uv radiation in microörganisms. (auth)

19651 ON TRANSPLANTABILITY OF YOSHIDA ASCITES TUMOR CELLS. I. TRANSPLANTABILITY OF THE CELL SUSPENSION AND EFFECT OF IRRADIATION. Tatsuo Tobe, Toshio Kato, Daikichi Hosaka, and Yonezi Yamamoto (Gumma Univ., Maebashi, Japan). Kitakanto Igaku, 13: 8-11(Jan. 1963). (In Japanese)

That anaerobic glycolysis of tumor cells is affected by irradiation was confirmed with Yoshida ascites tumor cells. However, anaerobic glycolysis of these cells is only transiently inhibited by x irradiation, and is restored after a lapse of time. In the case of in vitro irradiation, inhibition is observed after three min and glycolysis is restored to the initial level after 40 min. To investigate possible biological differences between cells with glycolysis inhibited and restored, Yoshida ascites tumor cells were investigated for transplantability. A cell suspension was injected intraperitoneally into four groups of 10 rats each. After 28 days observation, transplantation rate (death rate) and average survival time were obtained. The four groups were as follows: injected with nonirradiated tumor cells shaken for 3 min; injected with nonirradiated tumor cells shaken for 40 min; injected with tumor cells irradiated with 5000 r and shaken for 3 min (glycolysis inhibited); and injected with tumor cells irradiated with 5000 r and shaken for 40 min (glycolysis restored). Results indicate that: transplantability of tumor cells is not affected by physicochemical treatment; irradiation with 5000 r markedly lowers transplantability; there is no direct relation between inhibition of anaerobic glycolysis and the transplantability of tumor cells. (BBB)

19652 EFFECT OF X-RAYS ON CONTENTS AND METABOLISM OF 5-HYDROXYTRYPTAMINE IN EXPERIMENTAL ANIMALS. Mirjana Jovic Randic. Lijecnicki Vjesnik, 85: 1287(Nov. 1963).

Cerebral serotonin and urinary 5-HIAA in normal and adrenalectomized rats 5 min and 2 and 24 hours after whole-body irradiation with 900 or 8000 or 12000 r were studied. The effects of iproniazid and reserpine were also studied. (TCO)

19653 THE QUESTION OF RADIOTOXINS. Endre Czeizel, Gyorgy Vaczo, and Pal Kertai (Országos Közegészségügyi Intézet, Budapest). Magy. Radiol., 16: 356-60 (1964). (In Hungarian)

Experiments were conducted to determine whether a radiotoxin is released not only when the hematopoietic system is irradiated, but also when any organ, tissue, or cell is so treated. Also considered was the question whether the toxic substances thus released are of the same, or varying, intensity and influence, depending upon their origin. A total of 153 rats were partially hepatectomized after which the regenerative capacity of the liver was tested following injection of various types of x-irradiated cell sus-

pensions (liver, muscle, erythrocytes, and leukocytes) and whole blood. Irradiation was done in vitro at 180 kv, 15 ma, 0.5 mm Cu filter, and a rate of 67.6 r/min. The injected liver tissue per animal amounted to 0.15 to 0.20 g; muscle tissue, 0.10 to 0.15 g, was irradiated after being homogenized in saline and injected in a 1-ml suspension. Two ml whole blood, mixed with sodium citrate before irradiation, was injected. Blood cell suspensions (0.5 ml) were also irradiated and injected, the red cell suspension containing ~10,040,000 cells/mm^3 and the white cell suspension ~50,600 cells/mm^3. Various groups of animals received both irradiated and nonirradiated suspensions. Results show that irradiated liver, muscle, red cell suspension, and irradiated blood hindered liver regeneration slightly. The results suggest that each of these irradiated tissues or cells releases radiotoxin. The irradiated embryo liver and leukocyte suspension, however, did not decrease the eight of the liver regenerating. The radiotoxin may represent catabolites or pathologic metabolites from cells having undergone radiation damage. These accumulated metabolites may then impair function of the organism. (BBB)

19654 FIELD STUDIES ON THE RELEASE OF STERILE MALES FOR THE CONTROL OF ANOPHELES QUADRIMACULATUS. Donald E. Weidhaas, Claude H. Schmidt (Dept. of Agriculture, Gainesville, Fla.). Mosquito News, 22: 283-91(Sept. 1962).

Preliminary studies on the development of the sterile-male technique with Anopheles quadrimaculatus had shown that doses of 8865 to 12900 r of γ radiation applied in the pupal or adult stage produced sterility in both sexes. Sterilized females mated to normal males produced no eggs, whereas normal females mated with sterilized males produced a normal number of eggs, but none hatched. When sterilized males were introduced into caged populations of normal males and normal females at ratios of 4:1:1 or less, no reduction in the total number of viable eggs was produced, but at ratios of 6:1:1 and 10:1:1 there was a reduction of about 80%. Because of these promising laboratory results, the research program on the sterile-male technique with A. quadrimaculatus was expanded to include field tests. In two such tests males sterilized in the pupal stage with 12000 r of γ radiation were released into natural populations. In one of these, a total of 328,900 males were released during an 11-month period (an average of 3700 males/square mile/week) at 9 to 10 release points on a small semi-isolated island in Lake Okeechobee, Fla. In the other, a total of 104,700 males were released during an 11-week total (average of 9500 males/week) at two stations about $\frac{1}{8}$ mile apart within an extensive breeding area in a tree-covered swamp flooded by rain water and spring-fed streams, located at the south end of Lake Panasoffkee, Sumter County, Fla. To determine if these sterile males caused any reduction of, or sterility in, the natural populations, the number of adult A. quadrimaculatus in resting stations and the viability of eggs from females collected from these resting stations were followed in the release and check areas. In the Lake Okeechobee experiment the release of sterile males may have decreased the abundance of A. quadrimaculatus during the first half of the experiment when the natural population was in a seasonal decline, but it had no effect when the natural population increased during the second half of the test. Release of sterile males in the Lake Panasoffkee area did not conclusively demonstrate any induced sterility in wild females. (BBB)

19655 DISTRIBUTION AND EFFECTS OF STRONTIUM-90 AND X-RADIATION ON THE TEETH AND SURROUNDING STRUCTURES OF THE RAT. J. F. Cleall, A. R. Fonts, and P. P. Dale (Eastman Dental Dispensary, Rochester, N. Y.). N. Y. State Dental J., 28: 445-9(Dec. 1962).

Long-Evans rats at the age of 8 months were administered ^{90}Sr (232 μC orally or 4.5 μC intravenously) and simultaneously or later exposed to whole-body doses (400 or 500 r) of x rays. Oral and dental tissues were examined histologically and autoradiologically 9-10 months after ^{90}Sr administration. In the lower incisor region the ^{90}Sr was localized in the supporting bone; thin compact bone in the coronal region was heavily laden, while less discrete areas were present in the alveolar bone near the developing root apex. Only slight Sr deposition was seen in the continuously growing incisor. The distribution in the upper incisor region followed a similar pattern, with ^{90}Sr present in the cortical plates and discrete areas in the alveolar bone. Only a little diffuse deposition was demonstrable in the incisor dentin. In the lower molar region the ^{90}Sr was present in the alveolar bone proper and cortical plates and to a lesser extent in the cancellous supporting bone. The cementum of molars was heavily laden, while root dentin was only slightly radioactive; hot-spots were observed in coronal dentin. Distribution of ^{90}Sr in the upper molar region was identical with that in the lower molar region. Discrete areas of radioactivity were found in the secondary dentin below the cusps of the molars. No differences in ^{90}Sr distribution and no consistent changes in tooth or bone morphology were apparent between the control and x-irradiated groups. Although alveolar bone near the developing incisor roots was heavily contaminated with ^{90}Sr, there was little incorporation of Sr into the developing dental tissues. The findings of marked attrition and incisor hypoplasia in gross examination were substantiated by soft x-ray radiologic studies. The low doses of ^{90}Sr administered to these adult animals were apparently below the threshold of dental tissue susceptibility to radiation damage, as seen by the absence of histologic changes. (BBB)

19656 EFFECT OF REPEATED X-IRRADIATION ON THE PROCESS OF DEGRADATION OF DEOXYRIBONUCLEIC ACID. B. Miletić, Ž. Kućan, and Dj. Novak (Institut "Rudjer Boskovic," Zagreb). Nature, 201: 106-7 (Apr. 4, 1964).

Bacteria were x irradiated at different time-intervals in order to determine the process of degradation of DNA. A series of experiments, in which the second dose was applied 40 min after the first, showed that the hypothesis that the two functions of DNA (genetic and physiological) are separated and that only one of them is sensitive to the action of x rays is likely and that irradiation induces a process that prevents the degradation of DNA. After the first dose of 10 kr the usual degradation of DNA was found, but the second dose of 10 kr was nearly without effect. Thus it is evident that some process preventing or stopping DNA degradation appears after irradiation. From the results it is believed that the degradative process is connected with protein synthesis. (P.C.H.)

19657 EFFECT OF X-RAYS ON THE MORPHOGENESIS OF THE EMBRYONIC CHICK TIBIOTARSUS. J. D. Biggers and R. B. L. Gwatkin (Univ. of Pennsylvania, Philadelphia). Nature, 202: 152-4(Apr. 11, 1964).

Rudiments of long-bones from embryonic chicks were exposed to doses of 0, 102, 256, 6401, 1600, and 4000 r and then studied. The results suggest that the length, wet weight, and dry weight are depressed in rudiments exposed to more than 256 r. However, statistical analyses indicate that only the effects produced by doses greater than 640 r are significant. The data also show that the rudiments exposed to 4000 r increased in length by 119%. Also, ex-

posure to 4000 r depressed the wet and dry weights after 6 days cultivation 49.5 and 55.8% of the non-irradiated rudiments, respectively, whereas the length was only depressed by 24.9%. From the results, it was concluded that cell division and hypertrophy in the tibiotarsus are independent processes. (P.C.H.)

19658 PRESERVATION OF FOOD AND STERILIZATION OF MEDICAL AND PHARMACEUTICAL PRODUCTS. A. THE PRESENT STATE OF PRESERVATION OF FOOD BY IONIZING RADIATION. K. Kaindl and H. Gaisch (Institut für Biologie und Landwirtschaft, Reaktorzentrum, Seibersdorf, Austria). Neue Tech., 6: No. B1, 36-48(Feb. 1964). (In German)

After a comprehensive historical survey of the efforts of research in the field of food irradiation, the present position is described. Radioconservation of easily perishable foods (meat, poultry, fish), not easily perishable foods containing more than 20% water (e.g. potatoes, fruit, fruit-juice) and not easily perishable dry foods (less than 20% water) such as maize, wheat, rice is considered. In special cases irradiated food could be cleared for human consumption. The danger of creating induced radioactivity in irradiated foods can be excluded with energies up to 4 Mev. (auth)

19659 PROGRESSIVE THORIUM DIOXIDE MYELOPATHY. George L. Maltby (Maine Medical Center, Portland). New Engl. J. Med., 270: 490-5(Mar. 5, 1964).

The case histories of three patients suffering severe neurologic injury after injection of ThO_2 contrast medium (Thorotrast) into the spinal canal for radiologic diagnosis are reported. All three showed severe and immediate systemic reactions, especially temperature rises. These cleared in a few days, and there was no apparent effect from the retained material for an average interval of 8 yr, when insidious neurologic symptoms began. A slowly but relentlessly progressive crippling caudo-equina syndrome then ensued. Motor symptoms appeared first, with stiffness, weakness, and progressive paralysis. Deep tendon reflexes disappeared. In two cases, pain was severe and progressive. In two, sensory findings appeared, less severe and extensive than the motor changes, but both objective and subjective (hypesthesia and paresthesia). The sensory changes were indicative of a peripheral or caudal lesion. In all three cases symptoms of neurogenic bladder appeared, and in two it is believed that secondary recurrent infection in the urinary tract was the major contributory factor to death. Two of the three patients have died, succumbing to the complications of this inexorably progressive myelopathy of the cauda equina, and the remaining living patient continues to show slow but relentless progress of this syndrome. It is suggested that, because of the similarity of the clinical picture, the intervals, and the long-term x-ray findings, that this syndrome is due to damage from the radioactivity of ThO_2 and its progressive injurious effect on nervous tissue or its blood supply or both. The literature reporting similar cases and ThO_2-induced lesions is reviewed. (BBB)

19660 ELECTRON MICROSCOPICAL STUDIES ON BONE MARROW CELLS OF IRRADIATED RATS. Kiyouhara Takikawa, Takashi Iwauchi, Susumu Hibino (Nagoya Univ., Japan). Nucl. Hematol., 3: XVIII-IX(Mar.-May 1964).

Albino rats of Wister strain were exposed to a single dose 700 r of x rays (LD 50-30 days) and their bone marrows were examined successively 7 times at increasing intervals from immediately after the exposure up to the 30th day. Radiosensitivity in fine structures of the marrow cells in general was in the order: mitochondrion, endoplasmic reticulum and outer nuclear membrane, Golgi body, and nucleus. Radiosensitivity to x rays was found to be high in the younger marrow cells, being low in monocytes and in plasma cells. (P.C.H.)

19661 PATHOLOGIC SIGNIFICANCE OF BLOOD VOLUME CHANGES IN UNTREATED POLYCYTHEMIA VERA AND AFTER P^{32} THERAPY. Tibor Burger, Bela Keszthelyi, and Janos Peer (Orvostudományi Egyetem, Pécs, Hungary). Orv. Hetilap, 103: 357-60(Feb. 25, 1962). (In Hungarian)

Ten patients suffering from polycythemia vera were divided into three groups for evaluation purposes. The first group (2 patients) consisted of the mildest cases in which the hematocrit values were 55% or less. The second group (2 patients) had a hematocrit values of 55% or higher, and the red cell and plasma volumes were higher than normal. The third group consisted of the severest cases with hematocrit values of 70 to 80%, red cell counts of 6 to 8 million/mm^3, and red cell and plasma volumes two to four times normal. Blood volumes were determined with ^{32}P or ^{51}Cr. The patients showed clinical improvement after the first treatment with ^{32}P and hematologic examination indicated that the red cell count dropped, while hemoglobin value, white cell count, thrombocyte count, and hematocrit decreased. After the second ^{32}P treatment the blood volume did not decrease appreciably, but plasma volume increased, leading to improvement of the patient's condition. Venesection may still be used as a therapeutic means when an immediate reduction of the blood volume is desired. This can be achieved by ^{32}P therapy only after several treatments. The ^{32}P dose varied with the severity of the illness from one treatment of five mC ^{32}P in the patients with hematocrits of 55% to two doses of 4.2 mC in those with values of 58%, and three mC ^{32}P in another patient with a hematocrit of 82%. (BBB)

19662 THE EFFECT OF HIGH CONCENTRATIONS OF HEAVY WATER ON ROOT DEVELOPMENT IN PISUM SATIVUM AND ZEA MAYS. Otto L. Stein and Gabriele M. Forrester (Montana State Univ., Missoula). Planta, 60: 349-49(1963).

The early effects of D_2O (50 to 90%) on pea and corn seedlings were examined. When the roots of intact pea seedlings are immersed in high concentrations (80 to 90%) of D_2O for 24 hr, no increase in root length occurs. Immediately above the root apex, swellings occur as a result of widening of cortical cells and parenchymatous components of the stele, and disturbances of the vascular pattern are also observed. In roots which are grown out after treatment, no laterals are found along that portion corresponding to the region of elongation at time of treatment. Their development is blocked at the primordial level. Growth rates of roots after 24-hr treatment are proportional to the D_2O concentrations applied. The mitotic index of pea roots approaches zero within eight hr after immersion in 70 to 90% D_2O. At concentrations lower than 90%, mitoses recommence while the roots are still in heavy water. The mitotic cycle appears to be partially phased as a result of the treatment. In corn roots, two mitotic blocks occur during the first hour of D_2O exposure; the first prevents the flow of cells into prophase, the second occurs at the end of metaphase. The prepro-phase block is released after $\frac{1}{4}$ hr and the renewed flow of cells added to the cells held in metaphase increases the mitotic index above that of the controls. After the first hour of treatment a general suppression of mitotic activity sets in. In peas the mitotic index drops continuously and more rapidly than in corn. Both peas and corn can adapt to

growth in 80% D_2O. Whereas all pea roots resume growth after the first 8 hr, those of corn require 48 hr before 1/3 of the population shows renewed mitotic activity. Thus, the monocot in most ways is much more sensitive to high concentrations of heavy water than the dicot. One exception may be in relation to anatomical changes brought about by this treatment, since peas showed much greater disturbances in vascularization. (BBB)

19663 RESISTANCE OF C_{57} BLACK MICE TO IRRADIATION LEUKEMIA. REMOTE IRRADIATION CHANGES NOT PREVIOUSLY REPORTED. Tadeusz Zebro, Janina Kowalczykowa, and Jerzy Stachura (Dept. of Pathological Anatomy, Krakow). Polski Tygod. Lekar., 18: 1878-84 (Dec. 9, 1963).

Report is made of a study in which leukemia was not induced in C_{57} black mice by usual irradiation procedures. Post-mortem examination, 10–17.5 months after irradiation, revealed however heretofore unreported non-neoplasmatic focal proliferations of endothelium and thrombi in the liver, spleen, and pulmonary vessels, of which the animals died, and which were considered late post-irradiation complications. None of the other organs were affected, and only in one case did the observed changes suggest neoplasm. (OTS)

19664 THE EFFECT OF IRRADIATED COCK SPERM ON FERTILITY AND HATCHABILITY. H. M. Hyre, H. Patrick, and Karl Nestor (West Virginia Univ., Morgantown). Poultry Sci., 42: 121-4(Jan. 1964).

Sperm from three breeds of chickens were exposed to ^{137}Cs γ radiation to doses of 333 to 2333 r at a dose rate of 4000 r/hr to determine the amount of irradiation needed to result in LD_{50} for fertility and hatchability. In order to determine breed effect on semen response to irradiation, Single Comb White Leghorns, Rhode Island Reds, and New Hampshires were used. The LD_{50} for fertility and hatchability was taken at a point where the treated group was reduced to 50% of the corresponding control group. There was a highly significant decline in fertility and hatchability as a result of irradiation, but no breed differences were evident in either fertility or hatchability. The LD_{50} for fertility for the Rhode Island Reds, New Hampshires, and White Leghorns, as determined graphically, was 1730, 1820, and 2030 r respectively. The LD_{50} for hatchability for the Rhode Island Reds and the New Hampshires was between 2000 r and 2333 r while that for the White Leghorns was exactly 2000 r. Fertility and hatchability response of Rhode Island Red semen to high doses of irradiation given at a dose rate of 40,000 r/hr was also determined. Compared to the results obtained at a dose rate of 4000 r/hr, irradiation at the higher dose rate was less damaging and the results were more variable. The LD_{100} for both fertility and hatchability was 9333 r. It is conceivable that the LD_{100} for hatchability was higher than that for fertility but the determination was limited by the absence of fertility. It was previously found that the LD_{100} for fertility was 6488 r and that for hatchability 5544 r using x radiation. In the present experiment the use of γ radiation may account for part of the difference in the results. (BBB)

19665 EFFECT OF WHOLE-BODY X-IRRADIATION ON PALMITATE-1-C^{14} METABOLISM IN THE RABBIT. E. E. Elko, W. R. Wooles, and N. R. Di Luzio (Univ. of Tennessee, Memphis). Radiation Res., 21: 493-500(Apr. 1964).

The metabolism of albumin-complexed ^{14}C-labeled palmitic acid was studied in x-irradiated rabbits to denote alterations in triglyceride formation. Rabbits exposed to 1000 r of whole-body x irradiation manifested a normal intravascular removal rate of labeled free fatty acid and an unaltered plasma FFA concentration during the hyperlipemic state. The conversion of albumin-complexed ^{14}C-labeled palmitic acid to plasma triglyceride was increased fourfold in the x-irradiated group, however. Liver triglyceride concentration in the x-irradiated animals was lower, but specific activities were comparable in sham- and x-irradiated groups. Data from the present study and previous investigations concerning the etiology of radiation lipemia are highly suggestive that a major factor in the genesis of radiation lipemia in the rabbit is an enhanced rate of formation of plasma triglyceride. (auth)

19666 EFFECT OF X-RAYS, ULTRAVIOLET LIGHT, AND CHEMICALS ON THE KINETIC PARAMETERS OF CHYMOTRYPSIN. Lorna K. Mee (Cambridge Univ., Eng.). Radiation Res., 21: 501-12(Apr. 1964).

The effects of various agents on the kinetic parameters K_m (Michaelis constant) and V (maximum velocity) of chymotrypsin were studied. X irradiation increases K_m and decreases V. In solution, chymotrypsin is more sensitive when irradiated in the absence of oxygen; in the dry state, the enzyme is more sensitive when irradiated in the presence of oxygen. The effect of uv light on chymotrypsin in solution appears to depend on the wavelength of the incident light. The effect of urea or heat is to decrease V without change in K_m, whereas peracetic acid increases K_m without change in V. The implications of the observed changes in the kinetic parameters of chymotrypsin in relation to the structure of the enzyme are discussed. (auth)

19667 X-RAY-CONDITIONED SACCHARIN AVERSION INDUCED DURING THE IMMEDIATE POSTEXPOSURE PERIOD. Dale D. Morris and James C. Smith (Florida State Univ., Tallahassee). Radiation Res., 21: 513-19 (Apr. 1964).

A total of 136 male Sprague-Dawley rats approximately 100 days of age were used to explore the possibility of motivational consequences of irradiation persisting after conclusion of exposure. It was found that presentation of the saccharin solution as long as an hour after the 100-r x-ray exposure was adequate to condition a subsequent aversion to saccharin fluid. When the delay was as long as 6 hr, the mean S-score did not differ from that of the pooled controls. The results indicated that the motive state induced in a rat during 100 r of whole-body exposure does not dissipate for at least an hour after termination of the x-ray exposure. (auth)

19668 HEAVY ION LOCALIZATION OF SENSITIVE EMBRYONIC SITES IN TRIBOLIUM. John V. Slater, John Lyman, C. A. Tobias, N. M. Amer, J. S. Beck, Marian Beck, and A. J. Slater (Univ. of California, Berkeley). Radiation Res., 21: 541-9(Apr. 1964).

With the Berkeley heavy ion linear accelerator it was found that two relatively shallow sensitive sites exist in Tribolium which regulate wing differentiation and development. Both of these sites appear to have the same intensity and may lie within the membranous wing base areas. It is interesting that, as in mice, the developmental interval during which radiation must be applied to give the bulk of the incidence of the malformation is restricted to a very short time interval. A hypothesis was advanced that the primary intracellular effect of radiation in the embryo is the induction of somatic chromosome aberrations resulting in cell lethal action prior to or during mitosis. (auth)

19669 LYSOSOME PARTICLES AND SUBCELLULAR DISTRIBUTIONS OF POLYMERIC TETRAVALENT PLUTONIUM-239. Y. E. Rahman and A. Lindenbaum (Argonne National Lab., Ill.). Radiation Res., 21: 575-83(Apr. 1964).

Tissue fractionation studies were made of livers of rats 1, 8, and 28 days after they received a single intravenous injection of 0.5 μC of polymeric Pu, ^{239}Pu(IV). The subcellular distribution of the Pu was found to be nearly identical with the distribution of the acid phosphatase, indicating concentration of Pu in the lysosomal fraction. On the basis of the release of acid phosphatase from liver lysosomes, no difference in sensitivity to a nonionic detergent, Igepal-630, was found between the lysosomes of rats receiving plutonium and of uninjected controls for at least 14 days after Pu injection. (auth)

19670 X-RAY-INDUCED HERITABLE DAMAGE (SMALL-COLONY FORMATION) IN CULTURED MAMMALIAN CELLS. Warren K. Sinclair (Argonne National Lab., Ill.). Radiation Res., 21: 584-611(Apr. 1964).

Colonies of diploid Chinese hamster lung cells (strain V) surviving large doses (1500 r) of 250-kvp x rays have a broad size spectrum which is shown to be due to the variable growth rate of the colonies. The properties of large and small colonies were compared after isolation and subcultivation. Large colonies give rise to fast-growing populations of high plating efficiency which have the same radiosensitivity as the parent unirradiated cells. Small colonies of 50 cells or more at 12 to 14 days are viable and give rise to sublines which have slow growth rates, poor plating efficiency, and increased radiosensitivity (D_0 changed from 205 rads to ~145 rads, n unaltered). The chromosome number spectrum is broadened for all surviving colonies, severely in some cases to modal tetraploid numbers; but neither this, nor the high frequency of chromosome aberrations, appears to be involved in the radiosensitivity of the survivors. Reirradiation of small-colony populations appears to produce a further spread in clone size but no further changes in the radiosensitivity of individual clones. (auth)

19671 THE RADIATION SENSITIVITY OF TRANSPLANTED LYMPHOMA CELLS AS DETERMINED BY THE SPLEEN COLONY METHOD. R. S. Bush and W. R. Bruce (Univ. of Toronto and Ontario Cancer Inst., Toronto). Radiation Res., 21: 612-21(Apr. 1964).

An assay system for the number of viable cells in suspensions of transplanted AKR/J lymphoma cells, based on the enumeration of colonies in the spleens of non-irradiated recipients, is described. This method has been used to examine the radiation sensitivity of these cells and has yielded a survival curve with D_0 of 114 ± 4 rads and an extrapolation number for cells irradiated in vitro with ^{60}Co γ rays of 0.71 ± 0.16. The data presented suggest strongly that the spleen colonies used in the assay are, in fact, clones of malignant cells. (auth)

19672 LIFE SPAN, TUMOR INCIDENCE, AND INTERCAPILLARY GLOMERULOSCLEROSIS IN THE CHINESE HAMSTER (CRICETULUS GRISEUS) AFTER WHOLE-BODY AND PARTIAL-BODY EXPOSURE TO X-RAYS. Henry I. Kohn and Paul H. Guttman (Univ. of California, San Francisco). Radiation Res., 21: 622-43(Apr. 1964).

For the young adult Chinese hamster, about 135 days old, the mean age at death and its 99% confidence limits were found to be 1045 (887 to 1170) days for the males, and 959 (820 to 1003) days for the females. Young adults were subjected to whole-body or partial-body x-ray (250-kvep) exposure. The following results apply to those hamsters alive 100 days after exposure (about 235 days of age). After a whole-body dose of about 550 rads ($LD_{10(30)}$), the decrement in median life span was about 220 days in both sexes. For each additional 100 rads (up to a total dose of 900 rads), about 140 more days of decrement occurred. The life-shortening effect therefore is relatively more severe than in other species, although the $LD_{50(28)}$ is relatively higher. Judged by survival, the anterior half of the body (anterior to the xiphoid process) was much more vulnerable than the posterior half when these regions were irradiated separately. Furthermore, the response to whole-body exposure appeared to be determined largely by the dose to the anterior half of the body. A total of 49 tumors at eleven body sites was found in 309 autopsied animals, an overall incidence rate of 0.16. A significant increase resulting from irradiation was established only in the case of the ovary, where the most common tumor was the theca cell form. The data suggested the possibility of an increase in leukemia, in renal tumors, and in interstitial cell tumors of the testis. Progressive intercapillary glomerulosclerosis, a process associated with aging, was observed in the kidneys of all animals examined. This lesion was accelerated by irradiation and, in general, was similar to that described in the mouse. Study of the pancreas revealed no evidence of the histological changes commonly associated with diabetes mellitus in the Chinese hamster, nor of other degenerative or neoplastic disease. Therefore diabetes could be excluded as a cause of the renal lesions observed in aging and irradiated animals. The present results indicate that the Chinese hamster should prove to be a valuable animal for studies in radiobiology, oncology, and aging. It is easily maintained, has a low spontaneous rate of tumor incidence, and has a relatively long life span; it is susceptible to tumor induction by irradiation. (auth)

19673 POSSIBLE BONE INJURIES IN TELECOBALT THERAPY. E. Siracká (Inst. of Cancer Research, Bratislava). Radiobiol. Radiotherap., 4: 641-5(1963). (In German)

Physical dosimetry demonstrates that the dose given to bone in telecobalt therapy will not be greater than the dose to the soft parts; thus the risk of bone injury in the treatment of malignant tumors is a theoretical one. In utilizing the various advantages of telecobalt therapy one aims to improve the curability rate by increasing the tumor dose. From the hitherto existing clinical experiences with conventional x-ray therapy, certain correlations between skin tolerance and the rise of osteoradionecrosis would be supposed. It is the question which relations are valid in this sense in telecobalt therapy and to which extent other factors participate in the mechanism of bone injury. A case of an osteoradionecrosis of the second rib in connection with a carcinoma of the breast is cited which rose after postoperative x-ray and telecobalt therapy. (auth)

19674 THE CELLULAR RADIATION REACTION OF LYMPHATIC ORGANS. H. Klug (Humboldt-Universität, Berlin). Radiobiol. Radiotherap., 4: 685-98(1963). (In German)

The thymic lymphocytes of young rats were examined by means of light and electron microscope 1, 3, 6, 12, and 24 hr as well as 3 days after the action of 300 r total-body irradiation. After one hr no radiation injured cells could be clearly determined. After 3 hr, however, they are frequent and most numerous after 12 hr, while 3 days following the irradiation no morphologically visibly injured cells could be found. In the morphologically visibly changed cells two types of reaction may be distinguished; cells having a very pyknotic nucleus which is electron-optically dense and

uniformly granulated, the cytoplasm being densified and the structures altered; and cells having a cleared nuclear structure, 1 to 2 nucleoles appearing distinctly. Their cytoplasm does not show any morphologically visible changes. After some days an acute phagocytosis of the necrolyzed cells in the organ will begin. (auth)

19675 HISTOCHEMICAL EXAMINATIONS OF THE BEHAVIOR OF SOME ENZYMES IN THE LUNG IN ACUTE RADIATION SICKNESS AS WELL AS AFTER LOCAL X IRRADIATION. St. Košmider and J. Jonek (Klinik für Innere und Berufskrankheiten der Medizinischen, Akademie, Zabrze, Poland and Histologische Institut der Medizinischen Akademie, Zabrze, Poland). Radiobiol. Radiotherap., 4: 699-710(1963). (In German)

Histochemical examinations of localization and activity of DPNH-diaphorase, succinic acid dehydrogenase, ATP-ase, alkaline and acid phosphatase, and nonspecific as well as E-600-resistant esterase were performed in the lungs of guinea pigs at various stages of acute radiation sickness and after local irradiation of the lungs. The radiation syndrome was caused by a single exposure of the whole animal body to an x-ray dose of 400 r. Pulmonary tissue was x irradiated with 400 r. Detection of enzymes was done 24 hr, 4 and 11 days after whole-body irradiation and 4 days after local irradiation. Results show a decrease of respiratory ferments in the lung after whole-body as well as local irradiation. This may be significant for the oxidation-processes. ATP-ase and alkaline phosphatase decreased with the two types of irradiation and this may be related to disturbances in the active substratum transport from blood to cytoplasm and the reverse. The reaction to acid phosphatase showed an increasing tendency, the cause of which was a quantitative increase of the phagocytal cells of the lung, which contain this enzyme in abundance. Thiolacetesterase decrease could be causally connected with disturbances of the fat metabolism. A quantitative increase of E-600-resistant esterase is explained with intensified protcolytic processes. (auth)

19676 CHANGE OF FUNCTION OF THE SUPRARENALS WITH ACUTE RADIATION INJURY. G. Dávid, L. Farádi, and D. Tanka (Rheumatology and Balneology Inst., Budapest). Radiobiol. Radiotherap., 4: 711-16(1963). (In German)

Male rats received a 800 r whole-body x irradiation. The suprarenal region of the rats was entirely protected by means of Pb. The corticosterone content of the blood draining off the suprarenal gland was determined in vivo, the ability of the suprarenals to synthesize corticosterone was estimated in vitro. The suprarenals were examined histologically. The results were compared with data of equivalent animals that were irradiated under identical conditions, but which were not protected by Pb. The corticosterone content of the venous blood with the screened suprarenals was found to increase rapidly and to show even after 48 hr higher values than the group of non-screened animals. In the unprotected animals the hormonal secretion in the terminal state virtually closed, whereas this phenomenon was not observed at all in the protected animals. The ability to synthesize throughout the experiment was higher in the protected group. This function may play a decisive part in the functions of resistance of the organism. (auth)

19677 ON BIOLOGICAL EFFECTS OF FAST NEUTRONS. I. K. Petrovich and Yu. I. Moskalev. Radiobiologiya, 3: 785-94(1963). (In Russian)

Data are presented on the effects of a single exposure to fast neutron irradiation on the life span and morphological composition of peripheral blood in 2.5- to 3-month-old white rats weighing 172 ± 2.0 g. Doses inducing 50% fatalities among the animals after 15, 30, 60, 120, 240, 300, and 420 days were found to be 408, 408, 408, 380, 362, 316, and 299 r, respectively. Differential analysis was made of the life span of animals for various dates following irradiation by 170 and 340 r. The dose-effect curve for various peripheral blood elements (neutrophils, lymphocytes, and erythrocytes) depend on the date of observation. (tr-auth)

19678 QUANTITATIVE ANALYSIS OF CERTAIN PECULIARITIES OF YEAST CELL RESTORATION FOLLOWING IRRADIATION. V. S. Barsukov (Pavlov Inst. of Physiology, Leningrad). Radiobiologiya, 3: 795-802(1963). (In Russian)

Radiation damage in diploid and polyploid yeast cells resulted in dominant lethal chromosome aberrations of potential and factual mutability. (R.V.J.)

19679 EFFECTS OF INCORPORATED RADIOACTIVE IODINE ON PROTOMETABOLISM IN CALCIFIED TISSUES. A. A. Prokhonchukov (Moscow Central Research Inst. of Stomatology). Radiobiologiya, 3: 803-4(1963). (In Russian)

Four sets of experiments were carried out with 156 inbred rats weighing 132.4 ± 3.6 g treated with a single dose of ^{131}I injected as carrier-free potassium iodide in doses of 0.5, 1, 2, and 4 $\mu C/g$ animal weight. Glycine, labeled with ^{14}C in the methyl group, was used for determining protometabolism in 636 specimens of calcified protein tissue obtained from irradiated rats that were put to death from 1 to 120 days following the exposure. It was found that a 0.5-μC dose of ^{131}I injected into rats induced a hypothyrosis, a 1 $\mu C/g$ dose induced a strong hypothyrosis, while 2 to 4 μC resulted in destruction of the thyroid gland. A weak resorption of jaw bone tissue was observed soon after the injection of 4-$\mu C/g$ doses. Fibrosclerosis of the jaw bone tissue was developed at later dates while neither teeth nor hip bone showed any effects. It was also found that the glycine metabolism disturbance is a direct function of the ^{131}I dose. (R.V.J.)

19680 OXIDATION-REDUCTION POTENTIAL AS INDEX OF RADIATION PROTECTION. G. V. Sumarukov (Moscow State Univ.). Radiobiologiya, 3: 805-8(1963). (In Russian)

The influence of various prophylactics on stationary redox conditions in mouse tissues in vivo was studied, and it is shown that the relation between the amount of protection and the shift in oxidation-reduction potential in a tissue may be used as an index of radiosensitivity. (R.V.J.)

19681 RESTORATION OF ESCHERICHIA COLI IRRADIATED UNDER VARIOUS CONDITIONS (IN THE AIR, IN NITROGEN, AND IN NITROGEN IN THE PRESENCE OF CYSTEAMINE). E. A. Val'dshtein and V. D. Zhestyanikov (Leningrad Inst. of Cytology). Radiobiologiya, 3: 809-14 (1963). (In Russian)

The restoration of E. coli depends on the conditions of irradiation. The least restoration was observed following irradiation in air (oxygen). Restoration was much greater after irradiation in the presence of cysteamine and was temperature dependent. (R.V.J.)

19682 EFFECTS OF WHOLE-BODY IRRADIATION ON NUCLEOTIDE COMPOSITION OF DNA IN THE SPLEEN AND SMALL INTESTINE IN RATS. V. E. Komar (Central Research Inst. of Roentgen-Radiology, Leningrad). Radiobiologiya, 3: 815-19(1963). (In Russian)

Whole-body exposures to 500 and 1000 r of x radiation disturbs the nucleotoid DNA composition in spleen and

small intestine. A considerable depression of thymine content and an increase in guanine content at the expense of a small reduction in absolute cytosine were observed 4 to 6 hrs following exposure. It was postulated that the changes result from disturbance in DNA synthesis. (R.V.J.)

19683 NEURO-GUMORALE SUBSTANCES OF DOG BLOOD DURING ACUTE RADIATION SICKNESS. I. CHANGES IN BLOOD ACETYLCHOLINE AND CHOLINESTERASE SYSTEM. N. E. Kuznetzova (Inst. of Neurology, Moscow). Radiobiologiya, 3: 820-8(1963). (In Russian)

Experiments carried out on 13 male dogs, 2 to 5 years old and weighing 10 to 20 kg, showed that in the initial stages of chronic radiation sickness the blood content of acetylcholine increased and the cholinesterase decreased. Moreover, the increase in the acetylcholine level during the first 3 to 4 hrs proceeded at a greater rate than the cholinesterase decrease. Shifts in the enzyme system were more pronounced in dogs with greater resistance. However, during the recovery period acetylcholine and cholinesterase restoration took place at earlier periods in dogs with higher resistance. Not only was the cholinesterase activity restored, but it increased to 1.5 to 2 times the initial level. The level of acetylcholine and cholinesterase was not restored in the blood of dogs during terminal periods. In dogs exposed to subacute doses, 300 r, enzyme normalization took place 29 to 41 days following exposure. Correlation of data on enzyme changes in single and chronic exposures indicated identical trends. It was postulated that acetylcholine-cholinesterase participate in compensating reactions of organisms during radiation sickness. (R.V.J.)

19684 ON DESOXYCYTIDINE EXCRETION WITH URINE FOLLOWING IRRADIATION OF RATS. M. M. Skurikhina and O. Ya. Tereshchenko. Radiobiologiya, 3: 829-32(1963). (In Russian)

Experiments on 81 white rats showed the dose dependence of desoxycytidine excretion in urine during the first day following irradiations of 0.05 to 10 kr. A 2.5 to 3 fold increase in the desoxycytidine excretion was observed in rats exposed to 50 r; 25 to 30 fold increases were observed in rats exposed to 800 r. Higher doses (5 to 10 kr) resulted in 40 to 70 fold increases. (R.V.J.)

19685 COMPARISONS OF γ- AND X-RAY RELATIVE BIOLOGICAL EFFECTS ON HUMAN CELL NUCLEI IN A TISSUE CULTURE. N. P. Dubinin and L. G. Dubinina (Inst. of Biological Physics, Moscow). Radiobiologiya, 3: 833-46(1963). (In Russian)

Relative biological effects (RBE) of γ rays on all phases of the human cell cycle in a tissue culture were compared to effects of x rays. It was found that γ rays induced less nuclear alterations and produced an average 57% less biological effects in all cycle phases. RBE in individual cycle phases varied from 17 to 84%. Gamma RBE on chromatid recovery is very small during prophase while in other phases it varies to 50%. Gamma RBE on chromosome aberrations is low (16.6%) until the final phase, after which it slowly rises (to 83%) in presynthesis. (R.V.J.)

19686 RADIORESISTANCE OF ESCHERICHIA COLI CULTIVATED UNDER CONTINUOUS γ IRRADIATION. V. D. Zhestyanikov (Inst. of Cytology, Leningrad). Radiobiologiya, 3: 847-54(1963). (In Russian)

Cultivation of E. coli B, B/r(Carnegie), and K 12 under continuous ^{60}Co γ irradiation (doses of 2260 and 550 r/day) produced strains that differed from the initial strains in radioresistance. The highest radioresistance was observed in an E. coli B strain. S-shaped dose-dependence curves were observed for many strains. (R.V.J.)

19687 EFFECTS OF X RADIATION ON THE REPRODUCTION OF SMALLPOX VACCINE VIRUS IN TISSUE CULTURE. L. A. Kamalyan and R. A. Ter-Pogosyan (Radiobiological Dept., Armenian Academy of Sciences, Erivan). Radiobiologiya, 3: 855-7(1963). (In Russian)

Infectious and hemagglutinic properties of smallpox vaccine virus in chick embryo cutaneous-muscular tissue irradiated with 20-kr of x radiation were investigated. It was found that the radiation induced increased virus reproduction. Accumulation of hemagglutinin did not differ in irradiated and nonirradiated cultures. (R.V.J.)

19688 EFFECTS OF γ RADIATION ON AUTOTROPHIC MUTANTS OF COLIFORM BACTERIUM UNDER CONDITIONS OF VARIABLE SYNTHETIC ACTIVITY. A. G. Skavronskaya, G. E. Fradkin, N. B. Borisova, and L. A. Zamchuk (Gamalei Inst. of Epidemiology and Microbiology, Moscow). Radiobiologiya, 3: 858-65(1963). (In Russian)

A complete cessation of cell reproduction in albumin and RNA synthesis and slowed DNA synthesis were observed during leucine starvation of leucine-dependent mutants. A removal of cytosine from the medium during the initial growth of mutants requiring cytosine stops the reproduction of cells, and synthesis of albumin, DNA, and RNA. However, the cells do not die during cytosine starvation (3-hr observation). Irradiation of autotrophic variations demanding leucine, histidine, and proline in a medium robbed of necessary amino acids results in enhanced lethal and mutagenic activity. Irradiation of cytosine dependent mutants results in more pronounced (hundred fold) lethal and mutagenic activity. Analysis of the obtained data and correlation with previous data showed a certain correlation between radiation effects and DNA synthesis that suggests an initial damage to DNA during γ-induced mutagenic activity. (R.V.J.)

19689 RADIATION EFFECTS ON THE MITOTIC CYCLE OF CORNEA AND INTESTINE EPITHELIA IN MICE. M. G. Chumak (Inst. of Radiation Physics, Chemistry, and Biology, Moscow). Radiobiologiya, 3: 866-74 (1963). (In Russian)

Effects of whole-body irradiation of mice (400-r doses) on mitotic cycles in corneal and intestinal epithelia were investigated using H^3-thymidine autoradiography. It was found that the interphase period in corneal epithelium is 6.5 times that in intestinal epithelium. Radioinduced mitotic changes in G_2-M and G_1-S blocks and disturbances in DNA synthesis were observed in both tissues. During the restorative period the G_2-M block recovers first, DNA synthesis is normalized next, and the G_1-S block recovers last. In corneal epithelium the above processes are slower than in the intestine. (R.V.J.)

19690 REMOTE EFFECTS OF γ IRRADIATION OF SEEDS ON THE DEVELOPMENT OF VARIOUS NICOTIANA PLANTS. A. M. Kuzin, E. K. Uzorin, and V. I. Chirkovskii (Inst. of Biology and Physics, Moscow). Radiobiologiya, 3: 903-8(1963). (In Russian)

Remote effects on N. tabacum and N. rustica plants raised from seeds irradiated with 0.5 to 80 kr γ doses were studied. A strong radioinduced depression in the development of Nicotiana plants was observed with 40-kr doses at an early stage of germination and with 5 kr at later stages. Irradiation of seed with 0.5- to 1-kr doses resulted in negligible increases of dry substance in 10-day sprouts. An increase of 25% in the dry weight harvest of N. rustica was observed following γ irradiation of seeds

to 1-kr doses. Irradiation of Nicotiana seeds with 0.5- to 1-kr doses resulted in an ~4 to 30% increase of nicotine content in comparison with controls. (R.V.J.)

19691 EFFECTS OF γ- AND FAST NEUTRON IRRADIATION OF GRAFTS ON THE GROWTH, DEVELOPMENT, AND MORPHOLOGY OF VLADIMIR TYPE CHERRY. G. N. Imamaliev (Inst. of Biology and Physics, Moscow). Radiobiologiya, 3: 909-14(1963). (In Russian)

Irradiation of cherry tree grafts at 343 r/min to total doses of 500, 1000, 2000, and 3000 r of γ radiation and 50, 100, and 200 rad of fast neutrons was studied. Greater survival was observed with instantaneous exposure to fast neutrons. Gamma rays stimulated the growth and general accretion of grafts. Radioinduced deviations from the standard were observed in the growth and development of grafts. Grafts growing from irradiated eyes were shorter during the vegetative period. (R.V.J.)

19692 ON THE NATURE OF "INVERSE" OXYGEN EFFECT UNDER EFFECTS OF IONIZING RADIATIONS. L. Kh. Eidus (Inst. of Biology and Physics, Moscow). Radiobiologiya, 3: 920-2(1963). (In Russian)

An attempt was made to find an explanation of the inverse oxygen effect (protective effects of oxygen in irradiated media). Experiments carried out with irradiated pepsin dissolved in phosphate or acetate buffer showed that the inverse oxygen effect increases with decreasing albumin concentration. With 0.1% albumin and over the inverse oxygen effect is negligible. In pure slightly acidified (pH-4.5) water without buffer neither the oxygen effect nor the inverse oxygen effects were observed even with very low albumin concentrations. Thus it appears that the presence of a third protector component (buffer) is imperative before the inverse oxygen effect takes place. With a buffer, but in the absence of oxygen, the radiation effect is identical to that in pure water. (R.V.J.)

19693 BONE CHANGES FOLLOWING RADIATION THERAPY FOR MALIGNANT LESIONS IN REGION OF THE PELVIS. Bryan L. Redd, Jr. (Emory Univ., Atlanta). Radiol. Clin., 33: 60-71(1964).

Spontaneous femoral neck fractures may occur after irradiation of the pelvic region. More than 300 such cases have been reported since 1950. The incidence ranged from 0.1 to 7.5% with 15 to 20% being bilateral. The ages of the patients ranged from 56 to 63 years. The post-treatment interval ranged from 3 months to 20 yr, but was generally shorter in elderly patients. Theories of pathogenesis are reviewed. Most fractures will heal with good union and if diagnosed early, conservative management may produce good results. If the fragments are displaced, internal fixation or prosthesis gives better results. This complication may occur after supervoltage irradiation. (auth)

19694 ACUTE RADIATION FIBROSIS OF THE LUNG. Milos Konecny and M. Kabela (Oncological Inst., Brno). Radiol. Diagn., 3: 27-32(1962). (In German)

Symptoms of radiation fibrosis of the lung appear from one to two months after termination of the radiation treatment. This latency period varies with the intensity of the radiation administered and the general physical condition of the patient. Anatomically the pathologic signs of fibrosis are destruction of the alveolar epithelium, degeneration and metaplasia of the bronchial epithelium, damage to the bronchial tubes, peribronchial, perivascular, and interstitial inflammatory processes, as well as cicatrization from broncho-pneumonia and atalectasia. The clinical evidence for these changes are dyspnea, cough (productive or nonproductive), elevated temperatures, and increased erythrocyte sedimentation rate. Pain with breathing indicates involvement of the pleura. Increased pulmonary circulation resistance may lead to cor pulmonale. With extensive fibrosis, functional damage to the lung parenchyma with hyalinization and calcification may impair circulation enough to be fatal. Increased fibrosis reduces long elasticity and vital capacity. During the latent period before appearance of the symptoms the air capacity of the affected area is increased, and radiologically there is a fine shadowing of the area, that has an appearance of pleuritis or pneumonitis, and this intensifies as fibrosis progresses. The changes are restricted to these areas. Differential diagnosis is required and it is necessary to differentiate between interstitial diffuse carcinomas, and cicatrizing inflammations that often accompany fibrosis. Vitamin K, often used to sensitize tumors to radiation, tends to promote fibrosis. Treatment of radiation fibrosis is essentially symptomatic, and therapy is difficult. Prednisone has some effect, but antibiotics are usually ineffective. (BBB)

19695 X-IRRADIATION OF THE TUMOR BED. I. A STUDY OF THE INDIRECT ACTIONS OF RADIATION ON TRANSPLANTABLE TUMORS. William C. Summers, Kelly H. Clifton, and Halvor Vermund (Univ. of Wisconsin, Madison). Radiology, 82: 691-703(Apr. 1964).

The effect of irradiating the transplantation site before the grafting of unirradiated tumor tissue (the tumor-bed effect, TBE) was shown to be dependent on the dose of x rays, with a maximum at 3000 r. A variety of histological types of tumors were disclosed to be inhibited by pretransplant irradiation. The influence of sex, hormonal status, strain, and possible genetic difference on the TBE were found to be minimal, but the nature of the transplantation site (subcutaneous tissue vs brain) played a critical role in the TBE. The radioinduced changes that give rise to the TBE persisted for at least nine months. (auth)

19696 CONSIDERATIONS ON THE ROLE OF SEROTONIN IN THE PATHOGENY OF THE HEMORRHAGIC SYNDROME IN RADIATION SICKNESS. C. Marinescu, O. Cavulea, and I. Plesca. Rev. Sanit. Mil., 59: 949-53(Nov.-Dec. 1963).

The discovery and properties of serotonin, especially its role in hemostasis, and the use of serotonin in various dosages for radiation sickness were reviewed. It was concluded that the effect of serotonin on the coagulation and its effectiveness as a radiation-protecting agent justify the attention being devoted to this substance. (OTS)

19697 THE INITIAL LEUCOCYTOSIS AND ITS POSSIBLE MECHANISM IN RABBITS AFTER A SINGLE AND WHOLE BODY γ-IRRADIATION. Siu-choun Ma and Cheng Wu (Inst. of Biophysics, Academia Sinica, Peking). Sci. Sinica (Peking), 13: 449-58(Mar. 1964).

Twenty-eight male sex-matured rabbits, each weighing 2 to 3 kg, were used for the study of the effects of single and whole body γ-irradiations of 100 r, 300 r, 500 r, 800 r, and 1000 r on the leucocyte levels of the peripheral and the central blood and on the quantitative changes of the cells of the heterophil series in bone marrow. No significant differences in the numbers of leucocytes of the peripheral and the central blood were found in animals before irradiation and in the non-irradiated ones. Significant increase in the number of leucocytes in the peripheral blood (being 51 to 82% greater) was observed in all groups 7 hr after irradiation, whereas in the central blood, the number of leucocytes decreased or maintained at the pre-irradiation levels with the exception of the 1000 r group which showed an increase but was still 48% less as compared with its corresponding peripheral blood. Hence, significant difference in the leucocyte levels of the peripheral and the central blood

was found 7 hr after irradiation in all irradiated groups. In the lower dose groups (100 r, 300 r, and 500 r), the leucocyte levels of the peripheral and the central blood 24 hr after irradiation fell below the pre-irradiation levels and approached one another very closely, whereas in the higher dose groups (800 r and 1000 r) only that of the central blood decreased and the peripheral blood was still in a state of leucocytosis. Hence, in the higher dose group, significant difference in the leucocyte levels of the two kinds of blood 24 hr after irradiation still persisted as in the case of 7 hr after irradiation. The difference in the number of leucocytes in the peripheral and the central blood during the period of the initial leucocytosis is probably brought about by the migration of a great number of leucocytes from the large blood vessels into the small ones (such as arterioles, venules, and capillaries) and through the walls of capillaries) leucocytes moved towards the injured tissues. Leucocytosis does not occur in the whole blood circulation and, in most cases, it only appears in the peripheral blood. The decrease in the number of leucocytes in the central blood concomitantly with the leucocytosis of the peripheral one suggests the possibility that it is the redistribution of leucocytes in blood vessels of different diameters rather than the accelerative discharges of the heterophils from the marrow that plays an important role in the initiation of leucocytosis. (auth)

19698 SCHISTOSOMIASIS: AGE OF SNAILS AND SUSCEPTIBILITY TO X-IRRADIATION. Alina Perlowagora Szumlewicz (National Inst. of Allergy and Infectious Diseases, Bethesda, Md.). Science, 144: 302-3(Apr. 17, 1964).

Studies on sensitivity of Australorbis glabratus to x rays have defined the chronological and physiological age at which the snail is most sensitive to radiation damage. Results showed that the dose producing 50-percent mortality at 30 days after irradiation increased with age but that at 90 days it was practically constant from 2 to 210 days of age. In view of the available data on recovery from radiation damage caused by doses from 6000 to 9000 roentgens it is suggested that doses above those causing 50% lethality at 60 days but below those causing 50% lethality for 30 days should be considered in setting up radiation barriers to control snails in water-distribution systems. (auth)

19699 KARYOMETRIC INVESTIGATIONS OF WALKER CARCINOMAS AFTER SINGLE IRRADIATIONS WITH DIFFERENT DOSES OF ^{60}Co GAMMA RADIATION OR 200-kv X RADIATION. Walfried A. Linden, Alfonso Castano y Almendral, and Rolf Frischkorn (Universität, Göttingen, Ger.). Strahlentherapie, 123: 1-12(Jan. 1964). (In German)

Depending on the kind of radiation and dose, characteristical differences of the mean nuclear diameter of the Walker carcinoma of rats irradiated with a single dose of ^{60}Co γ rays and 200-kv x rays were obtained, using karyometrical investigations. During the first 2 days after x-ray irradiation a significant increase of the mean nuclear diameter was found which was followed by a monotonous decrease. After γ-irradiation the mean nuclear diameter went through a minimum followed by a maximum at the 3rd and 6th day, respectively, after irradiation. In the course of time a strong decrease in the mean nuclear diameter to values similar to the ones obtained after x-ray irradiation was also found after γ irradiation. Distribution curves for nuclear diameters did not show the displacement of the maxima to the right, as was described in literature, after single ^{60}Co γ-irradiation or x-ray irradiation of the carcinoma tissue. On the contrary a displacement to the left was obtained which increases as a function of time after irradiation. This is explained with an increase of frequency of pyknotic nuclei. (auth)

19700 ON THE EFFECTS OF THE GAMMA RADIATION OF ^{60}Co ON THE GROWING LARYNX (CARTILAGE) OF THE RABBIT. Joachim Drabe and Theophil Hornykiewytsch (Universität, Giessen, Ger.). Strahlentherapie, 123: 13-17(Jan. 1964). (In German)

Several experiments were done to investigate the biological effectiveness of ^{60}Co γ rays on the growing larynx (cartilage) of the infantile rabbit. The γ rays were less effective than 200 kv x rays for single irradiation with doses varying between 500 to 3000 r. The relative biological effectiveness of ^{60}Co changed with the radiation dose. This factor was 0.67 for a dose below 1000 r, 0.71 between 1000 and 1400 r, and 0.75 for doses of 2000 r. The irradiation effect was determined by weighing the larynx and by planimetric measurements of its cartilages (thyroid cartilage, arytenoid cartilage, and cricoid cartilage). (auth)

19701 ON THE HISTOCHEMICAL INVESTIGATION OF CARCINOMA OF THE CERVIX DURING RADIOLOGINAL TREATMENT. Ferenc Tóth, Sándor Csoemoer, and Géza Szlepka (Universität, Budapest). Strahlentherapie, 123: 18-26(Jan. 1964). (In German)

Histochemical investigations were done on biopsies obtained from 23 patients with carcinoma of the cervix during irradiation treatment. The activity of alkaline phosphatase of the tumor cells was most sensitive to x-ray and radium irradiation; it decreased rapidly in the course of x-ray treatment and disappeared completely in radium treatment. The enzyme activity of the granulation tissue formed in the environment of the tumor was increased. Glycogen, glucoprotein, ribonucleic acid, and deoxyribonucleic acid had a great radiation resistance. Even the decaying tumor cell particles kept their PAS-positivity and pyronophily. Lymphatic vessels and plasma cells were of significant importance in the removal of decaying tissue proteins and carbohydrates. (auth)

19702 NUCLEOSIDE PHOSPHATE CONTENTS IN DIFFERENT ORGANS OF RATS AFTER WHOLE-BODY IRRADIATION. Heinrich Maass and Manfred Timm (Universität, Hamburg). Strahlentherapie, 123: 64-81(Jan. 1964). (In German)

Mono-, di- and triphosphonucleosides were determined in blood, liver, spleen, and thymus of rats after total-body irradiation with 3000, 8000, and 20,000 r. Compared to a total-body irradiation with 800 r an increase in the radiation dose caused only a partial amplification of the radioinduced changes of the nucleosidephosphate contents. An increased radiation effect was noted only in the spleen and was determined at certain intervals after irradiation. There was no significant amplification of the changes in the thymus found after 800 r. It is assumed, therefore, that a threshold dose (800 r or below) is sufficient to cause these changes. The displacement of the nucleosidephosphates found in liver after using sublethal doses could obviously not be determined after total-body irradiation with higher doses. Possible causes of the radioinduced changes of the nucleotide metabolism are discussed. (auth)

19703 BLOOD FORM AND SERUM PROTEIN CHANGES FOR RATS AFTER HIGH-DOSE WHOLE-BODY IRRADIATION WITH SIEVE PROTECTION WITH SPECIAL REGARD FOR SOME HISTOLOGICAL RESULTS. Siegmund Piller (Universität, Tübingen, Ger.). Strahlentherapie, 123: 82-98(Jan. 1964). (In German)

Excessive changes of blood count and protein values (hemoglobin, hematocrit, total protein, albumin, and γ-

globulins decreased considerably, α_1- and α_2- as well as β-globulins increased) were observed in decreased animals after increasing the total irradiation dose from 3270 to 4300, 4900, and 5400 r using a sieve for protection. In surviving animals, irradiated with 3270 and 4300 r, the changes in the corpuscular and humoral blood picture showed significant regeneration events as well as the typical picture of the chronic phasis of the nonspecific dysproteinemia. This was in agreement with the histological data obtained from liver, spleen, and kidneys. Using changes in the serum protein fractions and in the microscopic appearance of thin kidney slices from 3 rats sacrificed 11 months after receiving the radiation insult a "radiogenic-contracted kidney" with significant sieve hole effects could be found. The importance of recovery of the α_1- and α_2-globulin fraction while β- and γ-globulin values were still increased is pointed out. At the same time the decreased total protein and albumin values (as in a nephrotic syndrome) showed a tendency to normalize. Moreover, the effects on kidney protection by moving-field and high-voltage therapy are pointed out. (auth)

19704 MITOTIC EFFECTS OF IONIZING RADIATION EFFECTS ON THE MALIGNANT AND NONMALIGNANT EPIDERMAL HYPERPLASIA IN MICE. PART VI. EFFECTS OF SINGLE CONTACT IRRADIATION AFTER 60-DAY PRETREATMENT WITH CARCINOGENS OR TUMOR ENHANCER. Kai Setaelae, Bjoern Lindroos, and Otto Nyyssoenen (Universität, Helsinki). Strahlentherapie, 123: 99-124(Jan. 1964). (In German)

The nature of mitotic response was analyzed in malignant (provoked by a carcinogen, 9,10-dimethyl-1,2-benzanthracene, DMBA) and in benign (provoked by a non-carcinogenic tumor enhancer, Tween 60) epidermal hyperplasia in female mice of the skin-tumor resistant RA strain after a single exposure of the mouse back to a $^{90}Sr-^{90}Y$ contact source with a dose rate of about 1000 rad/9 min. The skin of the mouse back was pretreated with DMBA, and with Tween 60, respectively, for 60 days. During the pretreatment period, carcinomas developed in the DMBA group, whereas no tumors appeared in the mice pretreated with Tween 60. The dosages (60 γ of DMBA, and 97 mg of Tween 60, respectively) proved well suited to the purpose of the experiment in that the effect of the carcinogen manifested itself in a more pure manner. The skin was irradiated on the 61st day. In each series and in each mouse, 500 mitotic figures (normal and pathologic) and the corresponding non-dividing nuclei were registered at post-exposure hours 1, 6, 12, 24, 48, and 72. The total number of mitoses examined amounted to 80,000 and that of non-dividing nuclei to 1,423,200. Conclusions were drawn only when differences were highly significant ($P < 0.001$). The response to irradiation in the 60-day experiment proved entirely different in malignant and in benign epidermal hyperplasia. As in the 10-day experiment, mice with malignant hyperplasia responded by development of severe mitotic disturbances and by disintegration of cells. Thus this condition was much more sensitive to irradiation than the benign state. It is pointed out that in planning a rational radiation therapy for tumors, attention must also be paid to the second growth facet, cell maturation and its disturbances, and not only to the first, cell proliferation, facet. (auth)

19705 THE INFLUENCE OF COMBINED RADIATION ON THE ACTIVITY OF LACTIC ACID DEHYDROGENASE AND ON BLOOD FORM. Vladimir Volek and Zdenek Dienstbier (Univ. of Prague). Strahlentherapie, 123: 125-31(Jan. 1964). (In German)

Lactic acid dehydrogenase activity was determined in rats after percutanous irradiation with 100 and 600 r, after intravenous administration of 100 μC and after combined external and internal irradiation (600 r + 100 μC and 100 r + 100 μC). Changes in elements of the peripheral blood were investigated, also. An activity increase of lactic acid dehydrogenase was observed during the 4 week period of observation in those groups that had received combined internal and external irradiation. This activity increase is explained as caused by protracted damage to the hematopoietic system by combined irradiation. (auth)

19706 RADIATION INJURIES TO THE RIGHT HAND AS A RESULT OF AN OPERATIONAL ACCIDENT. Rudolf Grabiger and Otto Nehrkorn (Stadt. Krankenanstalten, Remscheid, Ger.). Strahlentherapie, 123: 132-8(Jan. 1964). (In German)

A working accident of a 23-year-old laboratory assistant is reported. He suffered a radiation injury to the right hand while handling the radiation exit window of an emitting x-ray tube on a fluorescence-spectrograph. The dose received was about 10,000 to 12,000 r. The vesicular skin reaction that appeared after 12 days finally disappeared after 78 days. The late reactions appeared after 277 days and a noticeable combination damage appeared after 13 months. (auth)

19707 INFLUENCE OF COLD TREATMENT AFTER IRRADIATION ON THE LOSS OF THE CHACTA DORSO-CENTRALIS ANTERIOR OF DROSOPHILA MELANOGASTER "SEVELEN" AND "BERLIN INBREED." Peter Schleuss (Universitat, Zurich). Strahlentherapie, 123: 139-45(Jan. 1964). (In German)

The phenocopies "loss of the chacta dorso-centralis anterior" (dca) and "spread wings" were produced in Drosophila melanogaster Sevelen and Berlin inbreed by irradiation of 5 hour old puppae with 3000 rad. Differences in sensitivity between both of the wild strains were found. Loss of the dca chactas could also be produced by exposing 5 hour old puppae to cold ($2 \pm \frac{1}{2}$°C). Exposure to cold had a radiomimetical effect. An extended cold period of 4 hours after irradiation showed a protective effect, but the differences obtained were not significant. The effects were more or less additive when the influence lasted for 12 hours. After irradiating puppae of different ages ($4\frac{1}{2}$ to $5\frac{1}{2}$ hours) an increase in radiation sensitivity could be observed for the modification "spread wings" every 15 minutes; for the modification "loss of the chacta dca" a decrease was found. The difference in radiation sensitivity was considered probably caused by a different velocity of development of both wild strains. (auth)

19708 FIBROBLAST PROLIFERATION AND ^{35}S-SULFATE INCORPORATION IN DIFFERENT VASCULARIZATION STAGES OF THE CORNEA AFTER ACTION OF BETA RADIATION. Reinhold Schuster (Universität, Göttingen, Ger.). Strahlentherapie, 123: 177-98(Feb. 1964). (In German)

A considerable proliferation and vascularization of the connective tissue of the cornea, which was artificially vascularized by administration of alloxan into the chamber of the eye and of terpentine into the lamellas was observed 20 days after perforation injury and irradiation with 2400 rep using a ^{90}Sr applicator. An increased ^{35}S-sulfate incorporation into the injured area and into the uninjured cornea areas, which were near the epithelium and the anterior chamber was measured. An inhibition of the ^{35}S-sulfate incorporation could be found in the granulation tissue of the cornea, which was not vascularized at the time of the injury after irradiation with 2400 rep. (auth)

19709 ON THE DIFFERENCES OF THE RADIATION INJURY TO TESTES OF RATS. A HISTOLOGICAL AND CYTOLOGICAL STUDY AT 2 AND 8 DAYS AFTER 600-r WHOLE-BODY X-IRRADIATION AND TEN DAYS OF PREIRRADIATION WITH 3 r DAILY. Lothar Diethelm and Werner Lorenz (Universität, Mainz). Strahlentherapie, 123: 207-25(Feb. 1964). (In German)

Three hundred and twenty-four male albino rats (130 to 180 g) received total-body x-ray irradiation with 1 × 600 or 10 × 3 and 1 × 600 r. Great differences in testicular reaction were observed in all experimental groups: 12 out of 29 rats or 9 out of 27 rats showed no histological damage of the testes two days after irradiation with 1 × 600 or 10 × 3 and 1 × 600 r. Five out of 29 rats or 3 out of 27 rats showed extreme damage to the testes. Eleven out of 29 rats or 5 out of 29 rats showed histologically no damage to the testes 8 days after 1 × 600 or 10 × 3 and 1 × 600 r. Nine out of 29 rats or 11 out of 29 rats showed extreme damage. The histological results were supplemented by cytological studies from touch preparations of the testes. There was no evidence that the sensitivity of rat testes to 600 r is influenced by 10 × 3 r. (auth)

19710 THE BEHAVIOR OF ACID PHOSPHATASE, THE UNSPECIFIC ESTERASE, THE E-600-RESISTANT ESTERASE, AND THE LIPOIDS IN THE ADRENAL GLAND OF GUINEA PIGS AFTER WHOLE-BODY AS WELL AS LOCAL X-RAY IRRADIATION. Jan Jonek, Edmund Stoklosa, and Janusz Koencki (Silesian Mediziniche Akademie, Zabrze, Poland). Strahlentherapie, 123: 226-35(Feb. 1964). (In German)

The behavior of lipids, of nonspecific esterases, of E-600-resistant esterase, and of the acid phosphatase in the adrenal gland of healthy guinea pigs as well as after total-body irradiation and a local irradiation with doses of 400 r each was studied. A decrease of lipids proportional to the radiation sickness was found in the total-body-irradiated animals; a smaller loss of lipids was found in animals irradiated locally. A decrease of activity of the nonspecific esterases could be determined after x-ray irradiation, which is probably connected with disturbances in the lipid metabolism. There was a considerable increase in activity of the acid phosphatase that was connected with damage to the lysosomes releasing the enzymes. An increased appearance of coarse granules distributed patternlike seemed to be the result of degenerative events in the cytoplasm. The tendency of the E-600-resistant esterase to increase in the adrenal glands after x-ray irradiation pointed out a proteolytic part of this enzyme. It was assumed, that the changes are caused by a direct effect of x rays on the adrenal glands and are indirectly accelerated by extra-adrenal noxae (decay products of protein and electrolytic disturbances in the total organism.). (auth)

19711 INVESTIGATIONS ON BIOLOGICAL RADIATION PROTECTION. PART 50. THE EFFECTS OF SEROTONINE ON THE FERTILITY OF MALE MICE IN THE CASE OF REPEATED WHOLE-BODY IRRADIATION. Hanns Langendorff, Margarethe Langendorff, and Hans-Joachim Melching (Universität, Freiburg i. B.). Strahlentherapie, 123: 236-48(Feb. 1964). (In German)

Even after repeated irradiation with sublethal doses (810 r), a high survival rate was observed in male mice that were treated with 5-hydroxytryptamine (serotonine) prior to irradiation. Pairing irradiated animals, treated with serotonine before irradiation, with nonirradiated female mice showed that the duration of radioinduced sterility was considerably shorter in male animals protected by serotonine than in irradiated but non-protected animals. After the sterility period fertility of irradiated and pre-treated animals was relatively high, using the number of litters as criteria. The infant mortality in the F_1-offsprings was significantly low. From the results it was concluded that serotonine increases the radiation resistance of the total organism including the semen-producing epithelium. (auth)

19712 INVESTIGATION OF THE EFFECTS OF LARGE-SURFACE UV- OR X-RAY IRRADIATION OF THE SKIN ON ERYTHROPOIESIS. Helmut Bergmann (Universität, Göttingen, Ger.). Strahlentherapie, 123: 249-53 (Feb. 1964). (In German)

Patients with dermatologic diseases received total-body irradiation with uv, x rays (dermatologic field technique), or with both types of radiation in rapid succession. All three types of irradiation caused an increase in reticulocytes in the peripheral blood similar in timing and degree. The type of dermatologic disease had no influence. (auth)

19713 OSTEORADIONECROSIS OF THE FEMORAL NECK AFTER TELECOBALT-THERAPY. Rudolf Grabiger (Universität, Mainz). Strahlentherapie, 123: 282-4 (Feb. 1964). (In German)

A case of post radiation osteonecrosis of the left femur in a 56 year old female patient with diabetes is reported. A fracture of the femoral neck was observed in an adipose patient 8 months after radiotherapy of an adenocarcinoma of the uterus. It was concluded that the osteoradionecrosis is a result of telecobalt therapy. The total dose was 5000 rad, of which 3890 rad were given with the telecobalt irradiation. (auth)

19714 THE X-RAY COMBINATION INJURY IN THE CLOSE IRRADIATION OF SKIN CANCERS. Dimiter Profirov (Universität, Plovdiv, Bulgaria). Strahlentherapie, 123: 285-9(Feb. 1964). (In German)

Seventeen hundred patients with carcinomas of skin or lips were treated with short source-skin distance x-ray irradiation. In 64 cases a combination damage developed, localized on the lower lip in 31 cases. The greater the administered radiation dose, the higher was the percentage of cases in which the development of an x-ray ulcer can be expected. (auth)

19715 TUBERCULOSIS AND LETHAL AS WELL AS SUBLETHAL WHOLE-BODY X-RAY IRRADIATION OF GUINEA PIGS. Eduard Gabler (Pathologische Institut des Wilhelminenspitals, Vienna). Strahlentherapie, 123: 290-305(Feb. 1964). (In German)

Lethally total-body-x-ray-irradiated (550 r) and simultaneously Tb-infected guinea pigs died earlier (1.5 to 3.2 days) than lethally irradiated control animals. A tuberculous focus formation could not be found microscopically or macroscopically in these guinea pigs or in sublethally irradiated and simultaneously infected animals. However, in tuberculous control animals, which were killed at this time, specific foci could be found in liver, spleen, and lungs. Using sublethal irradiation (300 r) and simultaneous Tb inoculation half of the animals died a radiation death and the rest died of tuberculosis. It was found that 86.4% of the animals die a radiation death and 13.6% because of tuberculosis when irradiated sublethally 30 days after infection. The greatest tuberculosis foci in these animals appeared in lungs, spleen, and especially in the liver ("destroyed liver"). Tuberculous giant cells of the Langhans-type were missing in case of irradiation and simultaneous tuberculosis. They appeared again about 20 to 30 days after irradiation. The native resistance to tuberculosis was very reduced in cases of simultaneous exposure; radioinduced cell shortage and cell damage per-

mit tuberculous focus formation only after overcoming the acute radiation syndrome in case of sublethal irradiations. (auth)

19716 OBSERVATIONS OF SKIN REACTIONS IN TELECESIUM THERAPY. Ingrid Harms and Helmut Kuttig (Universität, Heidelberg). Strahlentherapie, 123: 339-49(Mar. 1964). (In German)

Radiation reactions of skin, observed after tele-gamma-therapy with ^{137}Cs are discussed. Conclusions were made about the radiation response of surfaces in different body regions. An increase in skin tolerance to conventional types of radiation was obtained only if irradiation cones were not used. The increased radiation tolerance resulted primarily from the build-up effect of ^{137}Cs γ rays. (auth)

19717 STUDIES ON FAVORABLE EFFECT OF POST-RADIATION BLEEDING ON HEMATOPOIESIS AND SURVIVAL. IX. THE EFFECT OF POSTRADIATION BLEEDING ON INCORPORATION OF ^{59}Fe IN ERYTHROCYTES OF GUINEA PIG. Srdjan Hajdukovic and Ljiljana Petrovic (Inst. of Nuclear Sciences "Boris Kidrich," Belgrade). Strahlentherapie, 123: 412-17(Mar. 1964).

Incorporation of ^{59}Fe high specific activity among irradiated and irradiated and bled guinea pigs after doses of 280 to 320 r gamma rays was investigated. ^{59}Fe in quantity of 1 μC was injected subcutaneously to guinea pigs on the 9th day after irradiation, or the 9th day after irradiation and bleeding and then the activity of peripheral blood was followed from the 10th to 40th day after irradiation. Activity of peripheral blood in irradiated and bled animals was, during the whole experimental period, above the level of only irradiated animals. Even more, absolute values of incorporation during the time between the 10th and 20th day after application of ^{59}Fe were almost similar and above values in normal animals. The period of maximal incorporation of ^{59}Fe in peripheral blood corresponded to the period of reticulocytes crises. Examination with ^{59}Fe proved previous results that immediate bleeding after irradiation has a stimulative hematological effect causing faster erythroid regeneration. The hematopoietic system of guinea pigs was even capable of answering some of classic hematologic stimuli after the doses used. It was possible to influence hematological regeneration but stimulus had to be of higher intensity. (auth)

19718 ON THE SIGNIFICANCE OF THE QUANTITATIVE EXTRACELLULAR WATER SPACE CHANGES IN THE DISTURBANCE OF THE WATER EXCHANGE IN EXPERIMENTAL "INTESTINAL RADIATION DEATH." Zoltán B. Zseboek and Gyoezoe Petranyi, Jr. (Hungarian Academy of Sciences, Budapest). Strahlentherapie, 123: 420-8(Mar. 1964). (In German)

Changes of the extracellular space in several organs and the inulin permeability of the gastrointestinal tract were investigated using cases with the gastrointestinal radiation syndrome appearing after total-body irradiation with 1300 r. The method was used in rats after ligating the kidney hilus. The experiments were done 24, 48, and 72 hours after exposure to radiation. The early increase and the later reduction of the extracellular space in the total organism did not occur uniformly in the extracellular spaces of the single organs. The extracellular space of brain and muscle tissue was low even by the 24th hour, while the enlarged extracellular space of the small intestine showed a slight reduction at the 72nd hour. The extracellular space of spleen increased again at the 72nd hour. The increased inulin permeability of the intestinal wall was expressed at the 72nd hour by an apparent increase of the measured inulin space of the organism. It was concluded that the disturbances of the gastrointestinal water turnover are a biphasic reaction. (auth)

19719 THE EFFECTS OF A FRACTIONATED X-RAY IRRADIATION ON THE EMBRYONIC DEVELOPMENT OF THE MOUSE. Heniz Kriegel and Hanns Langendorff (Universität, Freiburg i. B.). Strahlentherapie, 123: 429-37(Mar. 1964). (In German)

After fractionated x-ray irradiation administered daily during the total pregnancy period of the mouse, an influence upon the embryonal development could not be observed with doses of 2.5, 5, and 10 r. After administration of 20 r per day, a small increase of malformation and resorption rate as well as a decrease in weight of the fetus could be observed. An interruption of the pregnancy during the fetal growth period was caused by a daily radiation dose of 80 r. (auth)

19720 INVESTIGATION OF THE INFLUENCE OF THERAPEUTIC PARTIAL-BODY IRRADIATION ON LIVER FUNCTIONS AND THE PROTECTIVE EFFECT OF ESSENTIAL PHOSPHOLIPIDS. Johannes Klemm and Hans Werner Pabst (Universität, Munich). Strahlentherapie, 123: 438-50(Mar. 1964). (In German)

The disturbance of liver functions caused by therapeutic partial-body irradiation or treatment with radioisotopes and cytostatic substances was investigated in 161 tumor patients before, during, and after treatment, using liver function tests. A probable protective effect of essential phospholipids was tested. A statistically significant disturbance of liver function occurred only after irradiation in the head-neck-area, from scattered radiation to the liver, during treatment with ^{131}I and cytostatic substances. A partial protective effect with essential phospholipids was shown. All other cases showed no significant disturbances of the function as far as could be determined with the tests used. (auth)

19721 BIOLOGICAL NITROGEN FIXATION. THE EFFECT OF IRRADIATED NITROGEN GAS ON NITROGEN FIXATION BY AZOTOBACTER. Bengt Zacharias (Karolinska Institutet, Stockholm). Svensk Kem. Tidskr., 76: 87-96(1964).

Five articles concerned with the effect of nitrogen gas on nitrogen fixation by Azotobacter are reviewed. Particular attention is given to culture media used, methods of analysis, and calculations. Results are summarized for work on: production, detection, and measurement of gas ions; nitrogen fixation in batch cultures of A. vinelandii; nitrogen fixation in batch cultures of different species and strains of Azotobacter; nitrogen fixation in continuous cultures of A. vinelandii; and enzymatic studies. It is concluded that the gas ions responsible for the increased nitrogen fixation observed in Azotobacter fed irradiated N gas are likely molecular N gas ions. (H.M.G.)

19722 THE REACTIVATION OF THE IMMUNE RESPONSE IN IMMUNOLOGICALLY SUPPRESSED ANIMALS. Michael Feldman, Amiela Globerson, and David Nachtigal (Weizmann Inst. of Science, Rehovoth, Israel). Sym. Fundamental Cancer Res., 16th, Houston, 1962, 427-49(1963).

Attempts were made to restore antibody production in x-irradiated rats and in rabbits made tolerant to protein antigen by 6-mercaptopurine. A restorative factor from normal spleen cells was analyzed, and the kinetics of restoration, mainly in x-irradiated rats, were studied. Rats, aged $2\frac{1}{2}$ to $3\frac{1}{2}$ months, were used in most of the x-irradiation experiments, and sheep red blood cells were used as the test antigen. X irradiation of rats was carried out in most experiments with a total-body dose of 550 r given at a dose rate of 56 r/min. In some experiments the rats

were exposed to 500 r. Injections of antigens and the cellular preparations in the reactivation experiments were carried out 24 hr after x irradiation. The cell suspensions were obtained by mechanical dissocation of spleen, liver, regenerating liver (six days after hepatectomy), and thymus. Evaluation of the restoration of agglutinin production in x-irradiated rats showed that normal rat spleen injected with the antigen restored the immune response and that the agglutinins obtained represented antibody formation by the irradiated recipient cells. The restoration was manifested in a shortening of the lag period and in incidence of reactive animals. The restorative activity resides in spleen cell nuclei, spleen DNA, and DNase-treated DNA. Studies of changes of DNA content of spleens of irradiated and reactivated animals and of the histologic picture of such spleens indicate that the restorative factors do not elicit a general nonspecific regeneration of the depleted cell population of the antibody-forming organs. Restoration, obtained by similar methods, was also studied in rabbits made tolerant to human serum albumin by 6-mercaptopurine treatment. After a discussion of the results in relation to the clonal concept of antibody formation and suppression, it was concluded that immunologic unresponsiveness is not a result of elimination of immunologically reactive cells but of the presence of nonreactive cells. Two alternative hypotheses are considered: the elective theory, which postulates that every cell is genetically predetermined to form every type of antibody; and the instructive theories of antibody production. Available data favors the elective theory, it is suggested. (BBB)

19723 EFFECTS OF X-IRRADIATION ON FINE STRUCTURE OF HELA CELLS. William R. Hendee, William Zebrun, and Frederick J. Bonte (Univ. of Texas, Dallas). Texas Rept. Biol. Med., 21: 546-57(1963).

Structural alterations in HeLa cells following exposure to x radiation were studied as part of a larger project concerning the chemical modification of radiosensitivity in an attempt to integrate some of the observed cytologic changes into a coherent pattern of radioinduced structural alteration. The cells were examined 12 hr to 4 days after exposure to 150 to 1700 r. The most frequently observed differences between irradiated and nonirradiated HeLa cells is the appearance of numerous large cytoplasmic vacuoles within irradiated specimens. This prominent vacuolization, occurring as early as 12 hr after irradiation, may be either confined within a limited area of cytoplasm or dispersed throughout the cell. Each vacuole is bound by an intensely osmiophilic membrane, with traces of a heavily straining substance often contained both within the vacuole and along adjacent cytoplasmic membranes. A generalized loss of well-defined structure frequently occurs in areas of cytoplasm of cells fixed as early as 12 hr following x irradiation. This loss of organized structure, in association with vacuolization, encompasses a large area of cytoplasm or may be confined to well-circumscribed regions of the cytoplasm. The formation of a complex, apparently disorganized membranous networks involving a considerable area of cytoplasm and often encompassing areas characterized by a dense, amorphous granularity, is frequently observed in x-irradiated HeLa cells, as is excessive vesiculation of the Golgi zone and surrounding cytoplasm. Small, ovoid bodies are frequently observed in x-irradiated HeLa cells, resembling structurally the so-called Roentgen-Blaeschen observed in x-irradiated Paramecium caudatum and P. aurelia and the Einschulusskoerperchen reported in γ-irradiated human cervical carcinoma cells. Cytoplasmic evaginations suggesting the occurrence of blebbing are frequently seen in HeLa cells following x irradiation, the blebs often containing mitochondria or arrays of concentric parallel membranes similar to those reported in x-irradiated human amnion cells. Little structural alteration is observed in interphase nuclei of x-irradiated HeLa cells except in the nucleoli, which often contain transparent structureless areas. Irradiated HeLa cells often contain a number of separate oval areas individually enclosed by a double limiting membrane. Some of these multiple areas contain dense, osmiophilic loci which may represent pycnotic chromatin. The magnitude of the dose seems to determine the number of affected cells rather than the degree of alteration within a single cell. Almost all HeLa cells exposed to 1000 r or more exhibit structural alteration, including cytoplasmic vacuolization and areas of ill-defined cytoplasm. At lower doses the alterations, although of similar appearance in those cells in which they occur, are observed in fewer cells. Most of the observed effects, including cytoplasmic vacuolization and the appearance of amorphous areas within the cytoplasm, occur within the first 12 hrs following exposure to radiation. Since a number of these alterations are also observed in nonirradiated control cells, it is probable that they are not all specifically characteristic of radiation damage. (BBB)

19724 MODIFYING EFFECTS OF ENVIRONMENTAL FACTORS ON THE SURVIVAL AND MUTATION FREQUENCIES OF UV-IRRADIATED ASPERGILLUS NIGER VAN TIEGHEM STRAIN (V_{35}). A. K. Mishra and P. Nandi (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 25: 89-198(Sept. 1962).

Aspergillus niger strain (V_{35}) was irradiated with uv rays and the modifying effects of temperature, pH of the media, variation of the constituents of the media, treatment with H_2O_2, and preincubation of spores were studied. Survival percentage decreased with the rise of temperature. The highest count of morphological mutations was obtained at 30°C, and biochemical mutations rose to peak at 35°C. Injurious effects of irradiation diminished with the age of the spores. Prolongation of the period of preincubation tended to increase the rate of killing. The frequency of mutation rose up to a certain limit followed by a decline. The lethality of uv rays was highest at pH 8.0 and scoring of biochemical mutants was maximum at pH 6.0. The action of H_2O_2 as a mutagen was negative but combined treatment with H_2O_2 and uv light showed increased killing rate over that of uv treatment only. (auth)

19725 RADIATION INDUCED ABERRANT PLANT GROWTH IN JUTE. PART I. THE STEM ABNORMALITIES. Rabindra Krishna Basu. Trans. Bose Res. Inst. (Calcutta), 25: 117-44(Sept. 1962).

Various kinds of aberrant plant growths affecting stems and leaves were observed in plants grown in the first generation after treatments with x rays and β rays from ^{32}P and ^{35}S on five varieties of jute. The stem abnormalities, in all cases, persisted until maturity while most of the leaf abnormalities did not continue beyond the seventh-leaf stage. The stem abnormalities included single or repeated bifurcations of growing shoots, increase in the number of lateral branches and fasciation. Attempts were made to correlate the morphological abnormalities with dosages of x rays and β rays from ^{32}P and ^{35}S. In all cases, treatments with ^{32}P produced more morphological abnormalities than with either x rays or ^{35}S. The S_1 populations were free from stem abnormalities. The possible causes of the morphological abnormalities were discussed. The phenomenon of bifurcation was considered as an expression of affected meristem; while excessive lateral branches were due to effects

of ionizing radiations on growth substance complex, possibly destruction of auxin. The results of genetical studied indicated no immediate genetic background of these abnormalities and their manifestation resulted from induced physiological and biochemical disturbances. The induction of bifurcation of growing shoot from near soil level was found to be economical. (auth)

19726 THE EFFECTS OF ANTIBIOTICS AND X-IRRADIATION ON THE SURVIVAL OF SCALE HOMOGRAFTS IN FUNDULUS HETEROCLITUS. Edwin L. Cooper (Brown Univ., Providence, R. I.). Transplantation, 2: 2-20(Jan. 1964).

The homograft reaction was studied in the teleost fish, Fundulus heteroclitus. A simple quantitative estimate of graft survival was made by taking daily counts of the number of melanocytes on six scale homografts. At 28 ± 1°C the endpoint of graft survival occurred maximally at three days as evidenced by the presence of disrupted melanocytes. Prolongation of homograft survival was attempted using antibiotics and x irradiation. The antibiotics, albamycin and neomycin sulfate, hardly affected the survival of homografts, while stylomycin and actidione prolonged the survival until the 8th and 9th days, respectively. At 500 r grafts survived one day past those of controls. At 1000 to 1500 r homograft survival was prolonged until the 9th and 7th days respectively. When host fish were irradiated at 2000 and 3000 r there was an increase in the number of deaths, due to the lethal effects of these dose levels. One fish irradiated at 2000 r lived with grafts intact until the 27th day. The majority of cases irradiated at 3000 r lived until the 11th day with one exception, a fish that lived with the grafts intact until the 15th day. (auth)

19727 THE EFFECTS OF DIFFERENT HOMOLOGOUS SPLEEN CELL DOSES AND DONOR-RECIPIENT AGES ON THE MORTALITY OF SUBLETHALLY X-IRRADIATED MICE. Ioulios A. Iossifides, Giancarlo F. Rabotti, and Marvin Brand (Jefferson Medical Coll., Philadelphia). Transplantation, 2: 33-7(Jan. 1964).

Early mortality is known to occur in sublethally x-irradiated mice following their infusion with homologous spleen cells. In experiments to investigate parameters influencing the phenomenon, BDF_1 mice given a standard dose of 675 r were infused with spleen cells from A mice. Appearance of early mortality increased with the size of the splenic inoculum. In other experiments recipient animals of different ages were used, and it appeared that aged mice were more resistant to the effects of the homologous spleen. Variations in the age of the splenic cell donors failed to modify the end result. It is concluded that the phenomenon of early death depends upon the size of the splenic cell inoculum and the recipient's age but that it is independent of the age of the spleen donor. (auth)

19728 ON LABILITY OF SEPARATE LINKS OF THE VISUAL ANALYZER OF RABBITS IN THE CASE OF RADIATION LESION. R. K. Arutyunyan and S. G. Ambartzumyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 43-55(1961). (In Russian)

A sequence of lability changes of separate links of the visual analyzer under the effect of a 500-r dose of x irradiation was studied in rabbits with electrodes chronically implanted in the cortex and subcortex. The lability was studied by recording biological currents with rythmic light stimulation. It is shown that after irradiation the bio electric activity of the cerebral cortex is broken with the subsequent changes in the elctroretinogram, and the lability of the subcortex is destroyed only in 2 to 3 days. The function of the visual area of the cortex is restored first, then this process is observed in the retina and still later in the subcortex. (auth)

19729 THE EFFECT OF IONIZING RADIATION ON COMPENSATORY PROCESSES IN THE CASE OF THE NEURAL SYSTEM INJURY IN WHITE RATS. L. S. Gezalyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 57-62(1961). (In Russian)

A study was made of the effect of ionizing radiation on compensatory processes after a partial or complete destruction of the cerebellum in 54 white rats. The cerebellum was destroyed from two sides in 14 rats, and from the right or left side in the remaining animals. The animals were under observation for 4 months. After the operation the rats developed typical cerebellum disorders which gradually disappeared in 35 to 45 days. Later on the animals received a total x ray dose of 285 r. Following the total irradiation, some indications of a complete decompensation of the previously restored cerebellum disorders were evident. The decompensation is shown to be due to a disorder of the conditioned reflex activity of the cerebral cortex and to the falling out of its compensatory function. (auth)

19730 CHANGES OF CERTAIN METABOLIC PROCESSES IN BLOOD CELLS AND HEMOPOIETIC SYSTEM DUE TO A TOTAL X IRRADIATION. E. A. Pareishvili, E. E. Pulatova, Yu. B. Heifetz, I. G. Batikyan, and D. G. Saakyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 63-74(1961). (In Russian)

Histochemical methods have been used to study some disorders of nucleic acids (DNA, RNA), peroxidase, fats and glycogen metabolism in blood cells; a disorder of nucleic acids, organic and inorganic iron exchange was studied in the hemopoietic system (spleen and lymph node). Morphological determinations of the peripheral blood cells and of the hemopoietic system were carried out simultaneously. The experiments were made on 130 white mice. The animals were exposed to a single lethal dose of 800 r. Investigations were conducted with the time intervals of 5, 20 min and 1, 2, 12, 24, 48, 72 hr. The decrease in the RNA concentration begins 5 min after irradiation and the RNA completely disappears by the time the animals die. The disorder in the DNA synthesis begins in 20 min, yet the DNA is present in the cells till the very end. In 5 min after irradiation a momentary increase in the number of peroxidase granules is reported. Immediately after irradiation the glycogen contents of the blood cells begin to decrease, in 12 hr its contents increase; in the liver neutrophils and spleen the decrease begins just after 3 hr, increasing by the 12th hr. The fluctuations in the fat content begin after 3 hr, increasing by the 12th hr. Following the irradiation, the organic iron content decreases. Inorganic iron is detected in the spleen in 3 hr. Morphological changes become evident in one hr following the irradiation, and they are intensified as the radiation sickness progresses. (auth)

19731 CHANGES IN THE BLOOD AND HEMOPOIETIC SYSTEM SHORTLY AFTER CASTRATION DUE TO A TOTAL X IRRADIATION. E. A. Pareishvili, E. E. Pulatova, Yu. B. Heifetz, I. G. Batikyan, and D. G. Saakyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 75-88(1961). (In Russian)

A study of changes in the blood system and of some aspects of metabolism (nucleic acids and glycogen), shortly after castration, due to a single total x irradiation is described. A penetrating radiation dose of 100 r in air was used in the investigation. The experiments were conducted

on male rabbits. The data obtained show that under the effect of this irradiation dose some changes in the blood system take place due to a certain disorder of hemopoiesis. The destruction of cells in hemopoietic organs is accompanied by the decrease of the nucleic acids level. The fluctuations of the glycogen level are of undulatory type. Examination of the blood and hemopoietic organs shortly after castration shows no significant changes in hemopoiesis. Nevertheless, some sharp changes in the spleen (stasis, hemorrhage), of the castrates are observed. On the 17th day, following the operation, the nucleic acids level in the cells increases, while the glycogen content returns to the initial amount. In the combination of castration with irradiation the changes in hemopoiesis and metabolic processes are of distorted character. Hemadynamic disorders predominate in the spleen as before. (auth)

19732 CHANGE OF THE PERIPHERAL BLOOD AFTER BLOODLETTING IN ANIMALS SUFFERING FROM ACUTE RADIATION SICKNESS. M. A. Movsesyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 89-97(1961). (In Russian)

The experiments were carried out on dogs and rabbits. An acute blood loss affects the course of radiation sickness and the blood picture, depending upon the amount of the blood discharged, time intervals between bloodletting and irradiation, and upon the dose and conditions of irradiation as well. In the irradiated animals the blood loss and the restoration of the lost blood take place against the background of compensatory and restoring mechanisms. (auth)

19733 INFLUENCE OF DECORTICATION ON HEMOPOIESIS OF IRRADIATED DOGS. E. A. Pareishvili and E. S. Mailyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 99-111(1961). (In Russian)

An attempt was made to examine the role the cerebral cortex plays in the mechanism determining disorders and restoration of a disturbed hemopoietic function in the case of an acute radiation sickness. Changes in the bone marrow were studied under the effect of a single total filtered x-ray dose of 600 r in conditions of bilateral decortication carried out 2 months prior to irradiation or 2 to 3 months after it (at a recovery stage). Irradiation combined with decortication brought about still greater suppression and disorder of hemopoiesis, especially in the case of preliminary decortication. Complete suppression and disorder of erythropoietic and myelopoietic functions of the bone marrow, an increase of the reticular cell percentage, a suppression of the ability of the polypotent reticular hemopoietic cells to differentiate into the blood cells, a suppression of the growth and compensatory regeneration of the blood cells are reported. (auth)

19734 PHAGOCYTOSIS AND CHANGES OF GLYCOGEN CONTENT IN BLOOD CELLS AND HEMOPOIETIC ORGANS OF IRRADIATED ANIMALS. E. E. Pulatova, Yu. B. Heifetz, and D. G. Saakyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 113-20(1961). (In Russian)

The purpose of the investigation was to study carbohydrate metabolism in blood cells, spleen, lymph node, and liver, and in this connection to show the relation between the process of phagocytosis, occurring in hemopoietic organs, and intracellular carbohydrate metabolism under the influence of irradiation. The experiments were made on white mice irradiated with an x-ray dose of 800 r. The glycogen content was estimated by the method of A. L. Shabadash. In one to three hours after irradiation an abrupt drop of glycogen content in the peripheral blood neutrophils is observed, while in the imprints of the liver and spleen there is reported a great number of glycogen-saturated leukocytes. A certain dependence of glycogen content in neutrophils upon the degree of phagocytosis is established. As phagocytosis becomes intensified, the glycogen content in neutrophil leukocytes decreases. The deficiency of glycogen in neutrophils is accompanied by its presence among cells (in the liver and spleen imprints). A greater glycogen content is reported to be observed in the phagocyte plasma. (auth)

19735 ON INFLUENCE OF IONIZING IRRADIATION UPON THE FORMATION OF ANTIBODIES IN A COMBINED ADMINISTRATION OF VARIOUS ANTIGENS. E. D. Stepanyan and T. H. Marukyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 121-30(1961). (In Russian)

Irradiation of rabbits prior to intravenous injection of cell antigens (erythrocytes, bacteria) was shown to suppress considerably the formation of antibodies. When antigens were administered prior to irradiation, the formation of agglutinins was not suppressed, while that of hemolysin was partly inhibited. Twofold immunization of the rabbits with similar antigens (erythrocytes or bacteria) stimulates the formation of antibodies. The subsequent irradiation offers an inhibiting effect only on repeated antigen stimulation. Immunization of normal rabbits with erythrocytes, and then with bacteria, stimulates the formation of agglutinins. The subsequent irradiation considerably suppresses the production of agglutinins. When nonirradiated rabbits are injected with bacteria and then with erythrocytes, the production of hemolysins is inhibited. The similar inhibitory effect in the production of hemolysins is also observed when the rabbits are irradiated after such immunization. (auth)

19736 PHAGOCYTIC ACTIVITY OF THE LEUKOCYTES OF IMMUNIZED RABBITS DUE TO IONIZING RADIATION EFFECT. E. D. Stepanyan and T. H. Marukyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 131-42(1961). (In Russian)

It was shown that intravenous immunization of rabbits with killed bacteria or sheep erythrocytes stimulates phagocytosis. X irradiation (300 r) of the animals changes phagocytosis undulantly, as does its administration before and after immunization. A twofold vaccination of the rabbits with homogenous antigen (bacteria or erythrocytes) renders phagocytosis more active. Irradiation between such vaccinations suppresses or normalizes phagocytosis. Immunization of the rabbits with heterogenic antigens increases phagocytosis, while irradiation between immunizations in a combination of bacteria + irradiation + erythrocytes suppresses or stimulates it, and suppresses or normalizes it in a combination of erythrocytes + irradiation + bacteria. Phagocytosis and the formation of antibodies in immunized and irradiated-immunized animals more often takes place in parallel. (auth)

19737 THE COURSE OF A SMALLPOX VACCINAL PROCESS AND THE FORMATION OF ANTISMALLPOX IMMUNITY IN RABBITS DUE TO THE EFFECT OF X IRRADIATION. L. A. Kamalyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 142-52(1961). (In Russian)

A study of vaccination process peculiarities in rabbits, previously irradiated with an x-ray dose of 700 r, shows that the course of the process grows worse, the duration of the local reaction becomes longer, the disease spreads and some of the animals die. A repeated infection of the rabbits (cutaneous and cerebral) shows that the intensity of antismallpox immunity is lower in irradiated animals than in nonirradiated ones in the case of primary and secondary

immunization. A total irradiation suppresses the process of hemagglutination. (auth)

19738 ON THE MECHANISM OF STIMULATING EFFECT OF LOCAL SKIN X IRRADIATION ON PRODUCTION OF AGGLUTININS AGAINST BACTERIUM PARATYPHOSUM B. R. A. Ter-Pogosyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 153-8(1961). (In Russian)

Two series of experiments were conducted to examine the effect of local x irradiation (400 r) on the production of paratyphoid B agglutinins in rabbits. The first series of the experiments showed that local irradiation stimulated the production of antibodies only under the condition that antigen was introduced into the irradiated skin area. In the case of irradiation and introduction of antigen (in various areas) no increase of agglutinin production was observed. The second series of the experiments showed that irradiation brought about a longer retention of antigen in the injection area and consequently, its longer effect upon the organism. This may be the factor determining the stimulating effect of local irradiation. (auth)

19739 INDUCTION OF BACTERIOPHAGES FROM E. COLI CULTURES UNDER THE EFFECT OF X IRRADIATION. R. A. Ter-Pogosyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 159-64(1961). (In Russian)

The possibility of inducing bacteriophages from E. coli cultures under the influence of various dose x irradiation was studied. Phage was induced only from 14 cultures out of 317. The greatest yield of the phage was obtained when applying comparatively soft rays and small doses of irradiation. When irradiating the cultures in the logarithmic phase of growth, the phage induction was observed more often than in their stationary phase. (auth)

19740 MORPHOLOGICAL AND HISTOCHEMICAL CHANGES IN THE SPLEEN AND LYMPH NODE OF WHITE MICE IN RESPONSE TO RADIATION AND ANTIGENIC EFFECTS. V. A. Akopova. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 165-72(1961). (In Russian)

Research was carried out on 90 white mice subjected to x irradiation (Series I), vaccination with a brucellosis vaccine (Series II), and to a combined action of these factors (Series III and IV). The spleen and lymph nodes were studied both morphologically and histochemically. When exposing the mice to a total x-ray dose of 335 r, visible destructive changes and the lowering of desoxyribonucleic and ribonucleic acid level were found to occur in the spleen and lymph nodes. In the case of a single vaccination of the mice with the brucellosis vaccine, a certain vaccinal hyperplasia was observed in the spleen and lymph nodes, the level of desoxyribonucleic and ribonucleic acid being normal. In vaccinating the white mice, following total irradiation, destructive changes along with a gradual lowering of desoxyribonucleic and ribonucleic acid level are observed in the spleen and lymph nodes. The total x irradiation following a single vaccination with the brucellosis vaccine, brings about slight destructive changes along with a simultaneous reticular hyperplasia in the spleen and lymph nodes. The levels of desoxyribonucleic and ribonucleic acids are high at all times. (auth)

19741 ON CHANGES OF GLYCOGEN CONTENT IN THE SPLEEN LEUKOCYTES DUE TO IRRADIATION AND ANTIGEN EFFECTS. V. A. Akopova. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 173-80(1961). (In Russian)

An investigation was made on 90 white mice subject to x irradiation, using a dose of 335 r (Series I), to vaccination with a brucellosis vaccine (Series II), and to a combined action of these factors (Series III and IV). When the mice received a total irradiation with a dose of 335 r, the leukocytes in the spleen imprints contained a moderate amount of glycogen varying considerably during a fortnight. The x irradiation of the same dose, followed by the action of the brucellosis vaccine, gave rise to an abrupt drop in the glycogen content of the leukocytes. Under the influence of antigen, followed by x irradiation, a considerable amount of glycogen in the leukocytes and the presence of antibodies in the blood were observed. (auth)

19742 THE EFFECT OF SOME VEGETATROPIC TOXINS UPON OXYGEN CONSUMPTION BY IRRADIATED RATS. S. P. Vlasenko and J. H. Garibyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 181-7(1961). (In Russian)

The experiments on rats show that under the effect of ionizing radiation (150 r) the oxygen consumption changes undulantly, being predominantly suppressed. Separate and combined administration of atropine and adrenalin markedly stimulates gas exchange, while a single injection of adrenalin before and after irradiation during the first 24 hr does not remove a suppression effect of ionizing radiation upon gas exchange. A multiple administration of the hormone after ionization removes a phase effect of irradiation upon gas exchange. Atropinization of rats after irradiation as well as a complex administration of atropine and adrenalin completely remove the suppression effect of ionizing radiation upon gas exchange. (auth)

19743 A COMPARATIVE STUDY OF X- AND γ-RADIATION EFFECTS ON THE VITAMIN B_{12} CONTENT IN THE LIVER AND KIDNEYS OF WHITE MICE. M. O. Pogosyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 195-7(1961). (In Russian)

A comparative study of x- and γ-ray effects on the B_{12} vitamin content has been made on 85 white mice. All the mice were given a 760 r dose of total irradiation. The vitamin B_{12} content in the liver and kidneys of the killed mice was determined 24 and 46 hr after the irradiation. In comparing the results of x- and γ-ray effects, a greater concentration of the vitamin in question in the liver and the kidneys of the mice irradiated with γ rays was observed. (auth)

19744 DYNAMIC CHARACTERISTICS OF PROTEOLYSIS OF ORGANS WITH HETEROGENIC CELL STRUCTURE DUE TO RADIATION LESION. R. G. Mkrtchyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 199-206(1961). (In Russian)

Some dynamic characteristics of proteolytic process changes in the spleen of white rats were studied. The experiments were conducted on the animals irradiated with x ray doses of 600 and 800 r. Proteolysis was indicated by the change in the amino nitrogen content in the spleen homogenates incubated at 37°C during 6 hr. In the spleen of the intact animals the processes of proteolysis develop continuously. In the course of the reaction after the third hour of incubation a plateau of about 2-hr duration is recorded, after which period the reaction is intensified again. The presence of the plateau in the course of the proteolytic reactions in the spleen of the irradiated animals seems to be due to unequal radiosensitivity of the spleen cells. A direct relation between the irradiation dose and the intensity of proteolytic processes in the spleen is disclosed. (auth)

19745 CHANGES IN PROTEOLYSIS OF THE KIDNEYS AND SKELETAL MUSCLES DUE TO RADIATION DAMAGE.

R. G. Mkrtchyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 207-12(1961). (In Russian)

Changes in proteolysis of the kidneys and skeletal muscles due to radiation damage in animals was studied. The experiments were carried out on white rats, irradiated with 600- and 800-r doses of γ rays. The data obtained show that irradiation of animals considerably intensifies proteolytic processes in the kidneys without influencing those going on in the skeletal muscles. The intensification of proteolysis in the kidneys is observed 24 hr after irradiation; then it progresses, reaching the maximum on the 7 to 13th day, depending upon the dose of irradiation. A direct dependence is reported between the intensity of proteolysis of the kidney tissue and the dose of the irradiation the animals received. (auth)

19746 RADIOSENSITIVITY OF VARIOUS FORMS OF MAIZE. V. O. Babayan and R. A. Azatyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 221-3(1961). (In Russian)

Several forms of maize were examined. The preliminary data show that a 5000-r dose suppresses all the maize forms tested. The complex hybrid VIR-42 is found to be the most suppressed one, then follows the simple hybrid Slava, while the inbreeding lines VIR-44 and VIR-38 are the last among them. The vitality or productivity of the forms tested decreases in the same sequence. The generative activity of all the forms appears to be suppressed to the greatest degree. Radiosensitivity may be supposed to be determined by the kind of maize and to depend directly upon the intensity of vital processes of the organism. Radiosensitivity of generative organs is higher than that of vegetative ones. This difference increases with the increase of the organism vitality. (auth)

19747 THE EFFECT OF IONIZING RADIATION UPON VIRUS INFECTIONS. L. A. Kamalyan. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 225-36(1961). (In Russian)

A review is given of the investigations made by Russian and other scientists dealing with the effect of ionizing radiation upon the origin, course, and development of immunity in the case of virus diseases. Some data on immediate influence of various types of radiation upon viruses are also presented. On the basis of analysis and generalization of the literature data, an attempt was made to determine certain peculiarities of the course and immunogenesis of virus infections in an irradiated organism and to outline some tendencies in studying the problem of ionizing radiation and virus infections. The importance of application of radiobiological methods in solving some vague aspects of antivirus immunity is also emphasized. (auth)

19748 STUDIES OF THE RELATIONS BETWEEN RADIATION SENSITIVITY, MUTATION RATE AND POLYPLOIDY OF TRITICUM. M. Manzoorul Iman. Thesis, Bonn, Universität, 1963. 81p. $2.00(Gmelin, AED-DISS. 63-311). (In German)

Triticum seed of 2 diploid, 7 tetraploid, and 2 hexaploid species was x-irradiated with 10 to 32.5 kr. No direct relation between polyploidy and radiation sensitivity was observed. The variety rufinigrum of the diploid species T. boeoticum is especially sensitive. Mutation rate of hexaploid material is lower than for the other species. The result indicates that radiation sensitivity of an organism depends on genotypical composition and not on the number of genomes. (Gmelin Inst.)

19749 CHANGES OF BLOOD COUNT AFTER TELECOBALT IRRADIATIONS. H. Fichte. Thesis, Würzburg, Ger., Universität, 1963. 21p. $2.00(Gmelin, AED-DISS. 63-307). (In German)

Changes in blood count are less marked after telecobalt therapy than after conventional x-ray therapy. Decrease of red and white blood cells is in general proportional to volume dose. The influence of irradiation on the general health of the patients is discussed. (Gmelin Inst.)

19750 THE INFLUENCE OF X-RAYS ON THE VITALITY OF DROSOPHILA MELANOGASTER. STUDIES OF MORTALITY, FECUNDITY, AND FERTILITY AFTER VARIOUS DOSES. H. Noethel. Thesis, Berlin, Universität, 1963. 80p. $2.00(Gmelin, AED-DISS. 63-288). (In German)

Drosophila melanogaster of both sexes was irradiated with 100-kv x rays using doses between 0 (controls) and 125 kr. Dose-effect curves for mortality are linear up to 90 to 100 kr. For higher doses other effects become important resulting in a higher mortality. Fecundity decreases with increasing doses up to 11 kr., when all females are sterilized. Mortality of offspring is proportional to dose. (Gmelin Inst.)

19751 INVESTIGATION OF FACTORS INFLUENCING RADIATION RESISTANCE OF MICROCOCCUS RADIODURANS. Jong Sun Lee. Thesis, Corvallis, Ore., Oregon State Univ., 1963. 99p.

Age-dependent fluctuation of radiation resistance of Micrococcus radiodurans was investigated. The fluctuation observed in cells grown in synthetic media was less than 10% during 44 hrs of growth. The cells harvested 9 hrs after inoculation were the most radiation resistant. The wet mass and DNA contents of these cells were low. When the culture was "shifted" from the synthetic media to tryptone-glucose-yeast extract media, the survival dropped from 12 to 4% but it rebounded to 15% in the subsequent 60 min. The DNA content of these cells was low in comparison to cell mass. Alkyliodides, 2,4-dinitrophenol, diphenylamine, malonic acid, maleic acid, ethylenediaminetetraacetate, N-ethylmaleimide, and iodoacetic acid were investigated for their radiation-enhancing effects on resting M. radiodurans cells in buffer. Among them, iodoacetic acid (IAA) was the most effective. IAA, at a nontoxic level of 100 μM, reduced the survival 1,000 fold at all levels of radiation. This radio-toxic effect was observed only when cells were irradiated in the presence of IAA. IAA also enhanced radiation bleaching of carotenoid pigments in the cells and produced with starch a blue-violet color upon irradiation. The starch-IAA mixture was developed as a chemical radiation dosimeter. The range of this dosimeter was from 30,000 to 500,000 rads. (Dissertation Abstr., 29: No. 8, Feb. 1964)

19752 EFFECTS OF MASSIVE DOSES OF GAMMA RADIATION (120,000r) ON THE CHROMOSOMES OF SUCCESSIVE GENERATIONS OF HYMENOLEPIS DIMINUTA. Mir Musharraf Hossain. Thesis, Knoxville, Tenn., Univ. of Tennessee, 1963. 113p.

The cumulative effects of radiation on the chromosomes of successive generations of Hymenolepis diminuta were studied. The cysticercoid stage of the worms in flour beetles (Tribolium confusum) was subjected to 15,000 r γ radiation. These irradiated cysts were fed to rats, where they developed into mature worms in the intestine. The eggs from these worms were fed to beetles, and the cysticercoids were subjected again to a dose of 15,000 r. The process was repeated for 8 successive generations, thereby building up the cumulative dose to 120,000 r. Four worms irradiated in this manner were separated and their descendants were further traced down through single worm

infection up to 4 generations, thus giving rise to 4 distinct groups. Chromosomes in meioses and mitoses of 19 adult worms belonging to the fourth generation were studied by aceto-orcein squashes of selected portions of the strobila. Three normal worms served as control. Chromosome lengths of each worm were determined from average lengths of chromosomes in mitotic metaphases. Chromosomes of irradiated worms appeared to have been altered in lengths, numbers, and morphology. Variations in chromosome number, above and below the diploid numbers of 12 were noted. Chromosome bridges and chromosomes exceeding normal length were seen in a few cells. On the basis of changes in chromosome lengths and structure, 4 different cytological strains were produced by the cumulative effects of radiation. Possible uses of these new strains in further cytological studies are suggested. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19753 ULTRAVIOLET-LIGHT INDUCED MUTATION IN BACILLUS SUBTILIS–ANALYZED BY TRANSFORMATION. Roy Alfred Jensen. Thesis, Austin, Tex., Univ. of Texas, 1963. 180p.

The kinetic course of uv-induced mutations in Bacillus subtilis was studied by following their postirradiation appearance in DNA transforming activity. Donor DNA was derived from uv-exposed cells and added to an isogenic recipient. The rigid experimental controls imposed upon the over-all procedure are described. The importance of checking mutational origins was emphasized. Two closely linked amino-acid markers were characterized for both spontaneous and uv-induced mutational stabilities for 3 combinations of 2 deficient loci. Results advanced the idea that a uv-inducible suppressor specific to one of the markers was exceedingly closely linked to the other amino acid marker. Further experiments using double prototrophs obtained by uv induction uncovered a nutritional effect, suggesting that the suppressor action had identity as a deficient repressor or "derepressed" mutant. Two possible types of regulatory alteration schemes are described. It was suggested that mutations whose origins involve deficiencies at regulatory loci may respond sensitively to metabolic conditions in contrast to deficiencies occurring at structural enzyme loc. Experimental results were compatible with this general scheme. A straightforward appearance of mutation transformants corresponded to onset of postirradiation DNA synthesis. This was followed by a plateau corresponding to DNA doubling time, indicating that mutations become integral genetic moieties at the time of DNA synthesis. A DNA extraction phenomenon and a recombination "selfing" phenomenon were examined, and it was concluded that they were not interfering in any direct manner with scoring of mutations. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19754 SYNTHESIS: BIOLOGICAL HALF-LIFE, ELECTROPHORETIC PATTERNS, AND CONCENTRATION OF RAT SERUM PROTEINS AFTER X-IRRADIATION. Gerald Mark Kollmorgen. Thesis, Iowa City, Iowa, State Univ. of Iowa, 1963. 61p.

The changes in concentration of various serum protein fractions in rats after 3000 of whole-body x irradiation were studied. Pre- and post-treatment serum samples from the same animal were separated by paper strip electrophoresis. The ratios of % post- to % pre-treatment values were compared for starved controls, fed controls, irradiated animals, spleen-shielded animals, liver-shielded animals, and spleen and liver-shielded animals. (A percentage figure refers to the % of total serum protein found in any particular fraction). The data indicated a disturbance in synthesis following irradiation but did not exclude an alteration in biological half life of the various fractions. The incorporation of ^{35}S-labeled L-methionine into serum proteins was studied using 12 starved rats as controls and 12 whole-body-irradiated rats. The data indicated an increase in synthesis rates when serum protein fraction concentrations were increased (α_1-, α_2-, and β-globulins) and a decrease in synthesis rates when serum protein fractions were decreased (γ-globulin and albumin). Additional experiments indicated that the biological half lives of the various serum protein fractions were not altered by irradiation. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19755 CHANGES IN TESTICULAR MORPHOLOGY AND REPRODUCTIVE CAPACITY OF MALE RABBITS FOLLOWING PRE-PUBERTAL EXPOSURES TO GAMMA IRRADIATION. Alfred Frank McFee. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 132p.

Groups of Dutch-Belted rabbits were given whole-body exposures to 0, 150, or 300 r of γ rays from a ^{60}Co source at 5, 12, or 20 weeks of age. The histological changes occurring in the testes were evaluated by biopsy samples taken at 2-week intervals for 11 weeks after exposure. Weekly semen collections were obtained from males in each group from 16 through 30 weeks of age; the fertility and the histological condition of the testes were evaluated at 30 weeks of age. Doses received by the testes were measured by midline implants of glass rod dosimeters in these organs prior to exposures. Exposures at 5 or 12 weeks of age caused a delay in the onset of sperm production. Sperm concentration and the percent of motile sperm were sharply reduced by exposures of 150 or 300 roentgens. A slow recovery of sperm producing ability occurred, but had reached only a little over 50% of the control level by 30 weeks of age. Exposure of 20-week old males caused a drastic decline in sperm output, from which some recovery was evident by 30 weeks of age. The total numbers of young sired by males exposed at 12 or 20 weeks of age were noticeably below the control level. Exposure of 5-week old males caused a sharp reduction in the number of gonocytes present in their seminiferous tubules one week later. Exposure of males at 12 or 20 weeks of age resulted in a maturation depletion of their germinal epithelium as a result of the death and/or inhibition of the type A spermatogonia. Regeneration of the epithelium from surviving spermatogonia was under way by 3 weeks post-exposure. The reduction in sperm output following exposures at 5 or 12 weeks was due primarily to reduced testicular size. (Dissertation Abstr., 24: No. 8, Feb. 1964).

19756 THE EFFECTS OF RADIUM ON CERTAIN GOLDFISH BLOOD CONSTITUENTS AND ORGANS. DeVon Wayne Linn. Thesis, Salt Lake City, Utah State Univ., 1963. 116p.

Goldfish were exposed to Ra by immersion under controlled experimental conditions to study clinical blood changes and Ra deposition in bone and internal organs. The overall objective was to develop some clinical method of detecting and measuring the degree of radioactive pollution by using changes within the fish as biological indicators. After exposure, the fish were removed, decaudated, and the blood extracted for analysis. The blood characteristics selected for study were the microhematocrits, total plasma proteins, white blood cell counts, and differential ratios (white blood cell composition). The fish were then dissected, and the bone and internal organs removed and radioassayed. Both tissues were able to accumulate Ra but the pattern of uptake and concentration was somewhat in-

consistent. Specific conclusions are summarized. Goldfish blood and bone reacted to the experiments in a manner similar to the responses recorded for other poikilotherms and homoiotherms exposed to corresponding conditions using other radioisotopes. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19757 WAVELENGTH-DEPENDENT EFFECTS OF LOW-ENERGY X-RAYS ON MAMMALIAN TISSUE CELLS. Walter Frederick Wegst, Jr. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 178p.

The response of mammalian tissue cells to x radiation was determined as a function of the wavelength of the radiation. Two parameters of cellular activity were used to measure the radiation injury to the cell: gross cell survival as measured by cloning techniques: and glucose metabolism as measured by the production of CO_2 and lactic acid. The cells used were strain L, clone 929 mouse fibroblasts. They were irradiated with x radiation of varying wavelengths, between 5.41 and 8.64 kev. The percentage survival of the cells was measured by a standard plating technique. Glucose metabolism was measured by feeding the cells C-14 glucose and measuring the radioactivity of the CO_2 and lactic acid produced after 2 hours of metabolism. The results of the survival experiments indicate that the 25% lethal dose of these cells varies by a factor of 3.3 between 5.41 and 5.90 kev. At 5.90 kev, the site of the initial radiation lesion is quite radiosensitive, as only 130 rads are required to kill 25% of the cells. The measurements of the radiation damage to glucose metabolism indicate that 10^4 rads are necessary to produce a depression in the production of CO_2 of approximately 30%. The depression in CO_2 production varies by a factor of ~2 between 6.40 and 7.48 kev. Under the same experimental conditions, the production of lactic acid is steadily increased as a function of radiation wavelength. It was concluded that the initial radiation response of the cells as measured by cell survival shows a definite wavelength dependence. The shape of the curve of dose per unit cell survival as a function of wavelength suggests that the element Mn is involved in the initial radiation injury to the cell. In the intermediate survival region between 50 and 75% survival, the data indicate that radiation injury is proportional to the range of secondary electrons produced in the cell. This fact suggests that cell death results from a single unique radiation interaction event. The data on the radiation depression of CO_2 production suggests that the element Fe is involved in the radiation interaction with this particular metabolic pathway, implying that the Fe-containing cytochrome enzymes may be involved in the initial injury to the mechanisms of aerobic metabolism of glucose. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19758 THE NATURE OF HYDRATIVE CHANGES AND CATIONIC SHIFTS IN THE OVER-TENDERIZATION OF BEEF MUSCLE RESULTING FROM IRRADIATION. Ahmed Adel Ismail El-Badawi. Thesis, Corvallis, Ore., Oregon State Univ., 1963. 133p.

The influence of irradiation-sterilization on the muscle characteristics involved in meat texture was investigated in an attempt to elucidate the over-tenderizing action of irradiation. The effects of treating the meat prior to irradiation were also investigated. Analytical methods were used to determine changes in muscle protein charges, water-holding capacity, acidic and basic groups, bound and free minerals, and glycine soluble extracts of the treated and control samples. The pH-water holding capacity curves were found to be a valuable technique for investigating some of the biochemical changes in the muscle proteins. The results showed that the irradiation-sterilization of beef musclw at 4.5 megarads caused tenderization of the meat. Beef soaked in an equal amount of distilled water for 72 hrs at 38°F prior to heat inactivation of the enzymes and irradiation was much firmer in texture than the unsoaked samples. Beef heated to an internal temperature of 160°F prior to irradiation also resulted in meat having a firm texture. However, irradiation tends to reverse the effects of soaking, heating, or the combination of these two treatments. The mechanisms by which the various treatments exert their effects are discussed. (Dissertation Abstr., 24: No. 8, Feb. 1964)

19759 A QUANTITATIVE STUDY OF MELOIDOGYNE HAPLA EGGS AS AFFECTED BY TEMPERATURE AND ULTRAVIOLET RADIATION. Paul Joseph Wuest. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 81p.

Meloidogyne hapla was propagated on Rutgers tomato roots, the egg masses harvested, and the eggs separated. A suspension of eggs was placed in van Tiegham cells, on glass slides, or on water agar and incubated for 30 days from 12 to 36°C at 3 degree increments. Hatching counts were made throughout the incubation period, and the data were fitted to polynomial curves. Eggs of M. hapla were exposed to a range of uv dosages, and hatching counts were made 10 and 20 days after irradiation. Each of 2 experiments was repeated 4 times with 6 replicates of each treatment. The data were subjected to a regression analysis using analysis of covariance procedures to determine if the line slopes in each experiment were the same. Hatching of M. hapla eggs decreased with increasing dosage, and young eggs were more severely affected than mature eggs. Preliminary pathogenicity studies indicated that the surviving eggs were more pathogenic than the population from which they originated. (Dissertation Abstr., 24: No. 8, Feb. 1964)

Radiation Effects Therapy and Countermeasures

19760 MODIFICATION OF RADIATION DAMAGE BY FRACTIONATION OF THE DOSE, ANOXIA, AND CHEMICAL PROTECTORS IN RELATION TO LET. G. W. Barendsen (TNO, Rijswijk, Netherlands). Ann. N. Y. Acad. Sci., 114: 96-114(Mar. 31, 1964).

Experiments are described on the relation between physical properties of different radiations and the possibilities of modifying the radiation response of cultured human cells by various experimental conditions, using the capacity for clone formation as a criterion. Dose-survival curves are presented for various types of radiation, α particles, deuterons, x and γ rays, and β particles and the relation between the relative biological effectiveness and the linear energy transfer is discussed and shown to be dependent on the level of damage considered. Experiments are described concerning the effects of fractionation of the dose. It was found that repair of sublethal damage occurs after irradiation with 250-kv x rays, but is absent after irradiation with α particles from ^{210}Po. The same differences were observed with cells equilibrated with N_2 during irradiations. Furthermore with single exposures, equilibration of the cells with N_2 has a pronounced effect on damage produced by 250-kv x rays, whereas only a small protective effect is observed with ^{210}Po α particles. The same differences between effects of 250-kv x-rays and x radiation were found with regard to the protective

action of cysteamine. With 250-kv x rays, a dose-reduction factor of 3.7 was obtained at a concentration of 25 mM cysteamine, whereas with α particles from ^{210}Po a factor of 1.2 was found. The results are discussed in terms of differences in the spatial distributions of the ionizations produced by the different radiations. (auth)

19761 REPAIR PROCESSES IN IRRADIATED MOUSE HEMATOPOIETIC TISSUE. J. E. Till and E. A. McCulloch (Univ. of Toronto and Ontario Cancer Inst., Toronto). Ann. N. Y. Acad. Sci., 114: 115-25(Mar. 31, 1964).

Two different techniques, the endogenous colony method and the transplantation method, were used to study radiation damage repair in colony-forming cells of mice irradiated with ^{60}Co γ rays. From survival curves resulting from the two methods, it was apparent that radiosensitivity of endogenous colony-forming cells is similar to that of transplanted colony-forming cells. Recovery of colony-forming ability in cells of the mouse hematopoietic system was demonstrated by determining the ratio of colony-forming cells surviving single and fractionated doses. Late repair processes commencing at 24 hr postirradiation and assumed to be the result of cellular proliferation were found to increase with time intervals up to 14 days between radiation doses, but to decrease between 14 and 20 days. Kinetics of late repair were studied in endogenous colony-forming cells. Residual injury is plotted as a function of time after a conditioning dose of 400 rads. (H.M.G.)

19762 RECOVERY FROM RADIATION INJURY IN MAMMALS. John B. Storer (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Ann. N. Y. Acad. Sci., 114: 126-37(Mar. 31, 1964).

An attempt is made to provide a statement of the problem with respect to mammalian recovery rate estimations. The few concepts on which there is now general agreement, as well as some of the many concepts on which there is widespread disagreement, are pointed out. It is hoped that this approach may contribute to the solution of the problem by defining it and by emphasizing areas where more data are needed and other areas where novel approaches are required. (auth)

19763 TREATMENT OF ACUTE TOTAL-BODY IRRADIATION INJURY IN MAN. G. Mathe, J. L. Amiel, and L. Schwarzenberg (Hopital Saint-Louis, Paris and Institut Gustave-Roussy, Villejuif, France). Ann. N. Y. Acad. Sci., 114: 368-92(Mar. 31, 1964).

The treatment of total-body irradiation injury is essentially based on a very intensive symptomatic therapy (maintenance of patients in aseptic conditions, rational and not systematic use of antibiotics, platelet transfusions when the level of these cells is below 50,000); allogenic bone-marrow transfusion is indicated in case of failure of this symptomatic therapy, whether the dose of irradiation is 100% lethal or less. (auth)

19764 OBSERVATIONS ON SUPRALETHAL WHOLE-BODY IRRADIATION AND MARROW TRANSPLANTATION IN MAN AND DOG. E. D. Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Ann. N. Y. Acad. Sci., 114: 393-402(Mar. 31, 1964).

Observations in patients and dogs given whole-body irradiation followed by transplants of isogenic or allogenic bone marrow are discussed: the ability of the individual's bone marrow to demonstrate autogenous recovery provided life can be maintained by supportive measures for a sufficiently long period of time; the efficacy of isogenic marrow infusion in allowing survival after otherwise supralethal doses of whole-body irradiation; and the inefficacy of homologous marrow transplants in man. (H.M.G.)

19765 SPECIFIC RESTORATION OF AGGLUTININ FORMATION IN X-IRRADIATED RABBITS BY NUCLEOPROTEIN FRACTIONS FROM IMMUNE DONORS. Herman Friedman (Albert Einstein Medical Center, Philadelphia and Temple Univ., Philadelphia). Ann. N. Y. Acad. Sci., 114: 444-59(Mar. 31, 1964).

Lymph-node cell-suspensions obtained from shigella-immunized donor rabbits were fractionated into subcellular preparations, including cell-free homogenate, nuclei, mitochondria, desoxyribonucleoprotein and ribonucleoprotein-containing fractions. No serologically detectable shigella agglutinins or antigens could be observed with these preparations. Injection into nonimmunized recipient rabbits, either nontreated or whole-body-irradiated with 425 r 24 hr previously, resulted in appearance of anti-shigella agglutinins in the sera of the recipients. The time and magnitude of the agglutinin response was relatively similar to that observed following transfer of control whole cell suspensions. A majority of recipient rabbits receiving cell-free fractions had detectable shigella agglutinins within three to nine days, with peak titers at nine to twenty days. Possible mechanisms responsible for the appearance of these agglutinins were discussed. (auth)

19766 EFFECT OF THYMUS TRANSPLANTATION ON RADIATION CHIMERAS. C. C. Congdon, Joan Wright Goodman, and J. W. Ferrebee (Oak Ridge National Lab., Tenn. and Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Ann. N. Y. Acad. Sci., 114: 460-7(Mar. 31, 1964).

To determine tissue sites in which tolerance first appears, fetal thymus cells of isologous or homologous type were given after foreign bone marrow in x-irradiated mice, on the theory that the thymus might initiate a new tolerant immune mechanism to supplant the presumable smaller number of immunologically competent cells injected with the adult marrow. Results demonstrated the immunologic competence of adult thymus cells by rejection of foreign marrow and, in one instance, acceleration of secondary disease. Fetal thymus cells did not show immunological competence nor did they significantly affect the course of secondary disease, with the possible exception of 27 males given A.CA fetal thymus. Fetal thymus grafts did not offset mortality from secondary disease. (H.M.G.)

19767 BONE MARROW AND SPLEEN PATTERNS IN MICE IRRADIATED AND PROTECTED WITH HOMOLOGOUS CELLS. Giancarlo F. Rabotti (Jefferson Medical Coll., Philadelphia). Ann. N. Y. Acad. Sci., 114: 468-79 (Mar. 31, 1964).

In irradiated animals, the recovery of the hematological elements was the same, whether it is spontaneous or it is induced by isologous protection. There is, however, a difference in the time that the cellular restoration is first noted. Myeloid restoration is similar in isologously and homologously protected animals; a striking difference, however, exists between the two combinations, because at no time during the postirradiation period is there a lymphocytic repopulation in the homologously protected animals. Recovery, therefore, in the sense of restoration of the hematologic condition modified by the irradiation, does not take place in irradiated animals protected with homologous bone marrow and spleen cells. There is an x-irradiation threshold for the induction of the homologous disease. This threshold determines the type of hematological recovery in mice irradiated and protected with homologous bone marrow. (auth)

19768 AUTOLOGOUS BONE-MARROW TRANSFUSION FOLLOWING CHEMOTHERAPY. Leo M. Meyer, Theodore

D. Fliedner, and Eugene P. Cronkite (South Nassau Communities Hospital, Oceanside, N. Y. and Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 114: 499-509(Mar. 31, 1964).

Data on patients receiving 0.2 mg/kg HN_2 and autologous marrow reinfusion at time of maximal depression of white blood cells, those receiving same dose without bone-marrow infusion, and on subjects who receive 0.3 mg/kg on four consecutive days are shown. As previously noted, reduction in leukocytes in the 0.3 mg/kg group who received no marrow is essentially the same as in the 0.2-mg patients. The recovery phase is slightly delayed in two patients in the 0.3-mg group, but one patient showed a rise which compared favorably with any of the 0.2-mg subjects. Differences were even less marked in the analysis of platelet changes. It is noteworthy that in all three groups, there is a rebound in total number of leukocytes and platelets in the recovery phase (more prominently in the latter). It would therefore appear that following administration of 0.8 or 1.2 mg HN_2/kg body weight there is no significant difference in the rate of fall or return to normal of leukocytes and platelets, regardless of reinfusion of autologous bone marrow at the time of maximal leukopenia and thrombopenia. Comparing these results with those of previously cited workers who reinfused autologous bone marrow within 24 hr after HN_2 injection, it appears that there was probably no protection afforded, as leukopenia and thrombopenia developed and recovery from these states occurred at about the same time in treated and untreated patients. (auth)

19769 THE FATE OF TRANSFUSED H^3-THYMIDINE-LABELED BONE-MARROW CELLS IN IRRADIATED RECIPIENTS. T. M. Fliedner, E. D. Thomas, L. M. Meyer, and E. P. Cronkite (Brookhaven National Lab., Upton, N. Y.). Ann. N. Y. Acad. Sci., 114: 510-27(Mar. 31, 1964). (BNL-6584)

The transfusion of bone marrow cells labeled with tritiated thymidine into autologous and homologous recipients was studied in rats, dogs, and man. Rats and dogs were irradiated with ^{60}Co. Human studies were made in six patients with far-advanced metastatic cancer. The most significant observation was the fact that bone marrow recovery was neither initiated by nor associated with any of the labeled transfused cells. However, in rats and dogs receiving fresh marrow cells, it was observed that these cells were found in various tissues and that they actually proliferated and matured, thus completing their life cycle prior to the regeneration of the marrow. (H.M.G.)

19770 RELATIVE ABILITY OF PARENTAL MARROWS TO REPOPULATE LETHALLY IRRADIATED F_1 HYBRIDS. Raymond A. Popp, Gerald E. Cosgrove, and Diana M. Popp (Oak Ridge National Lab., Tenn.). Ann. N. Y. Acad. Sci., 114: 538-48(Mar. 31, 1964).

The relative abilities of C57BL and 101 marrow to repopulate the hematopoietic system of lethally x-irradiated mice was determined. The disproportionately greater ability of 101 than C57BL cells to repopulate (C57BL X 101) F_1 recipients is reported, and data are given on the relative ability of marrow from other strains of mice to repopulate lethally irradiated mice. Consistent with the observation that C57BL marrow is less efficient that 101 marrow is the finding that the number of C57BL cells required to produce functional long-term marrow grafts was much larger than the number of 101 cells. Factors that might influence the differential in the growth ability of the two types of marrow are discussed. (H.M.G.)

19771 SOME REMARKS ON THE PHARMACOLOGY OF RADIOPROTECTANT AGENTS. Victor DiStefano (Univ. of Rochester, N. Y.). Ann. N. Y. Acad. Sci., 114: 588-96 (Mar. 31, 1964).

A striking parallelism between pharmacological activity and radiation protection was clearly demonstrated for serotonin, epinephrine, histamine, p-aminopropiophenone, and cyanide. This correlation permits the assignment of hypoxia as the probable mechanism whereby these agents protect against the effects of radiation. On the other hand, AET, although very active pharmacologically, probably exerts its radioprotective activity by means other than the production of hypoxia. The greatest limitation to the use of existing radioprotectants in man and higher animals is their toxicity. It is suggested that methods for attenuating the toxicity of the present effective compounds must be sought and new nontoxic agents must be devised utilizing established principles of radiation protection. (auth)

19772 THE DISTRIBUTION AND METABOLISM OF ORALLY ADMINISTERED 2-MERCAPTOETHYLGUANIDINE (MEG) AND BIS(2-GUANIDOETHYL) DISULFIDE (GED) IN PROTECTED MICE. Bernard Shapiro, George Kollmann, and Emanuel E. Schwartz (Albert Einstein Medical Center, Philadelphia). Ann. N. Y. Acad. Sci., 114: 597-601(Mar. 31, 1964).

Distribution and metabolism of orally administered 2-mercaptoethylguanidine (MEG) and bis(2-guanidoethyl) disulfide (GED) were observed in order to provide insight into the mechanism of AET. Male mice fasted overnight were fed ^{35}S-labeled MEG or GED by cannula. The animals were sacrificed 30 min after feeding and homogenates were prepared for ^{35}S analysis by liquid scintillation counting. Paper chromatograms and electrophonetograms were scanned for radioactive peaks of metabolites which were measured by planimetry. Identification of metabolites was carried out by synthesis of compounds suspected and comparison of behavior with the unknowns in several chromatographic and electrophoretic systems. Results indicate that MEG is absorbed from the intestinal tract more rapidly than GED. This explains the observation that mice given an oral dose of 400 g/kg MEG 30 min prior to irradiation are better protected than mice given an oral dose of 400 mg/kg GED at the same time. The chemical forms which correlate with protection are P.B.-S^{AET}, GED, and S-acetyl-2-mercaptoethylguanidine, all of which are higher in the tissues after MEG feeding than after GED feeding. Although the experiments did not reveal the mechanism of action of AET, they do indicate the important chemical forms present in the tissues at the time of radiation, and they suggest manipulations that may improve protection by means of this agent. (H.M.G.)

19773 STUDIES CONCERNING THE NATURE OF THE PROTEIN-BOUND PROTECTIVE AGENT IN THE TISSUES OF MICE GIVEN BIS(2-GUANIDOETHYL) DISULFIDE (GED). George Kollmann, Bernard Shapiro, and Emanuel E. Schwartz (Albert Einstein Medical Center, Philadelphia). Ann. N. Y. Acad. Sci., 114: 602-6(Mar. 31, 1964).

The presence of disulfide and thiolester bonds between the protective agent and tissue protein in protected animals was determined qualitatively and quantitatively. Tissue homogenates were dialyzed against water and then against cysteine, taking the additional amount of radioactivity removed from the protein, as a measure of mixed disulfide bonding of ^{35}S-labeled bis(2-guanidoethyl) disulfide (GED). Thiolester bonds were measured by dialyzing tissue homogenates against water and then against hydroxylamine, taking the additional amount of radioactivity removed from the protein as a measure of thiolester-binding of ^{35}S-labeled GED. Results of the work indicate that the

protective agent is bound to the protein by a thiolester bond as well as by a mixed disulfide bond. (H.M.G.)

19774 CHEMICAL PROTECTION AGAINST RADIATION IN TUMOR BEARING MICE. Emanuel E. Schwartz, Bernard Shapiro, and George Kollmann (Albert Einstein Medical Center, Philadelphia). Ann. N. Y. Acad. Sci., 114: 614-21(Mar. 31, 1964).

Sulfur-35-labeled AET, both in its reduced and oxidized forms; namely, 2-mercaptoethylguanidine (MEG) and bis(2-guanidoethyl) disulfide (GED), was injected into adult mice that had previously received a subcutaneous inoculum of isologous mammary adenocarcinoma. Animals were sacrificed within 20 min or 2 hr later; various organs and tumors were assayed for radioactivity; and the different metabolites preseat were separated, identified, and quantitated by paper chromatography. Brain, subcutaneous mammary tumors, and testes were found to have the lowest concentrations of AET sulfur; while kidney, small intestines, and liver had the highest. The most prominent difference between mice carrying mammary tumors and normal mice is seen in the kidney where approximately twice the normal concentration is found in tumor bearers. Survival studies after whole-body irradiation revealed a prolongation of survival with MEG and GED in tumor-bearing mice as well as in normal mice. GED recipients survived longer than MEG recipients. The extent of x-ray dose reduction in locally growing mammary tumors in MEG and GED recipients was also determined. (H.M.G.)

19775 RECOVERY RATE AND DOSE-REDUCTION FACTOR IN CYSTEAMINE-TREATED MICE AFTER FRACTIONATED IRRADIATION. Arne Nelson, Ola Hertzberg, and Inga-Britt Henricsson (Research Inst. of National Defence, Sundbyberg, Sweden). Ann. N. Y. Acad. Sci., 114: 630-50(Mar. 31, 1964).

In order to investigate the protective effect of cysteamine at sublethal doses of irradiation, groups of mice were exposed to the following fraction doses: 80, 160, 320 r at time intervals of one, three, and seven days. The total doses were chosen to give lethalities from 0 to 100%. Half of the animals were given cysteamine before each irradiation. A simple mathematical model was used which fitted the results regarding the short-term lethal effects. The effect of cysteamine appeared to be a dose-reduction effect and not an enhancement of the recovery. The dose-reduction factor seems to be of the same order of magnitude at sublethal as at lethal doses. (auth)

19776 FURTHER OBSERVATIONS ON THE COLLECTION, STORAGE, AND TRANSFUSION OF PERIPHERAL BLOOD LEUKOCYTES. Vernon P. Perry, Carey C. Kerby, and Richard B. Gresham (National Naval Medical Center, Bethesda, Md.). Ann. N. Y. Acad. Sci., 114: 651-660(Mar. 31, 1964).

The peripheral blood of 15 guinea pigs was collected over a six-month period and processed by density differential centrifugation yielding a total leucocyte number of from 5.6 to 8.7×10^7 cells. The nucleated cells were frozen and stored in liquid nitrogen for periods ranging from 31 to 245 days and subsequently reinfused as a single inoculation into lethally irradiated donor animals. Four animals survived beyond the period of maximum survival of the control animals. It is suggested that inadequate cell numbers were employed in this study, and that perhaps larger numbers of cells infused over a longer period of time will prove to be more effective in protecting against the effects of lethal radiation. (auth)

19777 THE ASSAY OF THE TRANSPLANTATION POTENTIAL OF FRESH AND STORED BONE MARROW BY TWO IN-VIVO SYSTEMS. J. P. Lewis and F. E. Trobaugh, Jr. (Presbyterian-St. Luke's Hospital, Chicago and Univ. of Illinois, Chicago). Ann. N. Y. Acad. Sci., 114: 677-85(Mar. 31, 1964).

The transplantation of isologous mouse marrow in the fresh and thawed state was compared in two in vivo systems. Both assay techniques indicate good survival of the basic repopulating unit after storage in 15% glycerol. The spleen colony technique is more efficient and sensitive than the studies of mouse protection. Presumably, both techniques depend upon the ability of the marrow to repopulate. Utilizing this colony-assay system, dimethyl sulfoxide appears less efficient than glycerol in protecting the basic repopulating unit. (auth)

19778 RADIATION PROTECTION OF MICE WITH BONE MARROW AND SPLEEN PRESERVED AT LOW TEMPERATURE USING POLYVINYLPYRROLIDONE. Maxim D. Persidsky and Victor Richards (Presbyterian Medical Center, San Francisco, Calif.). Blood, 23: 337-40(Mar. 1964).

Previously reported results of low-temperature preservation of bone marrow with 10% polyvinylpyrrolidone (PVP) were re-evaluated on the radiation protection basis. The lethally irradiated mice show 80% recovery after the transplantation of PVP-preserved isologous bone marrow, when compared to the recovery rate of the mice receiving fresh marrow. Slightly higher recovery resulted from the marrow preserved with glycerol. The spleen cells preserved with PVP also induce high recovery in irradiated mice. (auth)

19779 INFLUENCE OF 19 NORANDROSTENOLONE PHENYLPROPIONATE ON RECOVERY IN TOTALLY IRRADIATED ANIMALS. G. Caprino and F. Gallina (Università, Perugia, Italy). Boll. Soc. Ital. Biol. Sper., 39: 1687-91(Dec. 31, 1963). (In Italian)

Doses of 10 mg/kg of 19-norandrostenolone phenyl propionate were administered parenterally to adult rats for three days before total-body x irradiation and for four days afterwards. The irradiation doses were 400 r and 600 r. Female rats were used, since steroids with androgenic activity cause a mortality increase in male rats when administered after irradiation. Five lots of 10 animals were used; the first was treated only with the steroid, the second was irradiated with 600 r, the third irradiated and treated with the steroid. The fourth and and fifth lots were similar to the second and third except that a 400-r irradiation dose was used. The animals treated solely with the steroid showed a significant increase in wt which continued even after the end of treatment. The animals irradiated with 600 r died between the 5th and 10th day after treatment and showed a rapid loss in body wt. In the third group, eight died before the 12th day after a steady loss of wt; one died on the 18th day after losing wt less rapidly than the animals which were only irradiated, and one died on the 32nd day after regaining initial wt. Half of the animals irradiated with 400 r died between the 7th and 13th day after progressive loss of wt (intestinal death), while the other had a slight decrease in body wt and died between the 14th and 19th day (hemopoietic death). Those irradiated with 400 r and treated with the drug showed wt loss for three days; four of these died between the 7th and 12th days with progressive wt loss; three died between the 14th and 24th day, and two of these with greater than initial wt; and three survived with increased body wt. (BBB)

19780 EFFECT OF PROPYLTHIOURACIL IN THE TOTALLY IRRADIATED ANIMAL. G. Caprino and F. Gallina (Università, Perugia, Italy). Boll. Soc. Ital. Biol. Sper., 39: 1691-2(Dec. 31, 1963). (In Italian)

The radioprotective action of propylthiouracil was studied in the rat. Eighty adult male rats were divided into 4 groups of 20 animals, which received doses of 600 r. One group was used as control; a second was treated with 10 mg propylthiouracil parenterally six hrs before total irradiation; a third was treated similarly with 15 mg propylthiouracil; and the fourth was treated with 10 mg daily for five consecutive days and then was x irradiated 24 hr after the last administration of the drug. The second and third groups of animals demonstrated a slight increase in survival time of little statistical significance. The animals treated with 50 mg died before the control animals; this is attributed to a probable summation of the toxic effect of propylthiouracil and the irradiation. Propylthiouracil thus does not exert a radioprotective action. This may suggest that, since in hypothyroidism there is a diminution of oxygen utilization but the tension of tissue oxygen is unchanged, the results of radiation are related to the presence of oxygen in the tissues and not to its means of utilization. (BBB)

19781 RELATIONSHIP OF THE DEVELOPMENT OF RADIATION DAMAGE AND REPAIR ON THE REGENERATIVE ACTIVITY OF TISSUES OF RANA TEMPORARIA TADPOLES. N. F. Gronskaya (Central Scientific Research Inst. of Medical Radiology, Leningrad). Bull. Exptl. Biol. Med. (U.S.S.R.) (English Transl.), 55: 215-18(Mar. 1964). (Translated from Byul. Eksperim. Biol. i Med., 55: No. 2, 108-12(Feb. 1963)).

Rana temporaria tadpoles aged 20 days were exposed to 300 or 600 r of x rays. The degrees of damage and recovery in the epithelium of the cornea, tail, and regenerating portion of the tail were studied, and differences were found that were related to the initial rate of cell division. The change of mitotic activity was used as a criterion of the extent of the injury and of the rate of the subsequent repair. The fall in mitotic index was more abrupt and pronounced in the cornea and epithelium where the rate of mitosis was relatively high. After radiation repair processes were more rapid in the tissues in which mitotic activity is normally high; nevertheless the recovery was incomplete. Regenerative activity was more distinctly shown after irradiation with a dose of 300 r; differences between the reactions of the various tissues to irradiation were less well shown with a dose of 600 r. (auth)

19782 PROTECTIVE CHARACTERISTICS AGAINST IRRADIATION OF CERTAIN NITRO DERIVATIVES OF MONOARYL-SUBSTITUTED AROMATIC AMIDINES. J. Baev and S. Robev. Compt. Rend. Acad. Bulgare Sci., 15: 613-16(1962). (In French)

The effects of the nitroamidines and of combinations of nitroamidines with other agents were tested in experiments on white rats. It was found that the inclusion of one or two nitro groups in the molecule of N-phenylbenzamidine and N-phenyl-4 toluylamidine reduced their toxicity and increased their protective activity. Specific results are tabulated and discussed. (D.C.W.)

19783 RESTORATION OF VIABILITY OF X-IRRADIATED L-STRAIN CELLS BY ISOLOGOUS SUBCELLULAR FRACTIONS. Danilo Petrović, Branimir Miletić, and Branko Brdar (Institut "Rudjer Bošković", Zagreb). Intern. J. Radiation Biol., 7: 131-9(Aug. 1963).

L-cells were homogenized, and nuclei, mitochondria, and microsomes were isolated afterwards. These subcellular fractions were added to cells irradiated with 500 r. In many experiments the irradiated and treated cells gave a considerably higher number of colonies than the irradiated nontreated cells, and the colonies of treated cells were much larger. Restoration was considerable on treating the cells with the nuclear fraction. Mitochondria and microsomes were not so active in restoring from the killing effect of irradiation. The addition of subcellular fractions to nonirradiated cells had some effect on the plating efficiency of cells and the appearance of colonies, but not so great as to explain the restorative effect as a phenomenon of increased plating efficiency. In the subcellular fractions intact or viable cells were not detectable. In some cases the addition of subcellular fractions produced no effect. (auth)

19784 EFFECT OF CYSTAMINE AND CYSTEAMINE ON X-IRRADIATED HAIR FOLLICLES. V. Smoliar (Université, Liege). Intern. J. Radiation Biol., 7: 145-50(Aug. 1963).

A whole-body irradiation of 500 r, given to 10-day-old rats during the anagen stage of the hair growth cycle, is followed in five to six days by the depilation of the skin. The changes in the hair bulbs consist of an arrest in mitotic activity, acute cell destruction, abortive mitotic recovery, second wave of cell destruction, and final mitotic recovery with overshooting. Intraperitoneal cystamine, which protects against the hair loss, decreases the second wave of cell destruction and promotes slightly the final mitotic recovery. The effect of cysteamine, which does not prevent the depilation of skin, is much less marked. It is suggested that the radioprotective effect of cystamine consists in preventing the pyknotic degeneration of the first post-irradiation mitoses in the matrix cells, an effect on cells approaching division at the time of exposure. (auth)

19785 THE EFFECT OF PROTECTORS ON SERRATIA MARCESCENS DURING ANAEROBIC X-IRRADIATION. D. L. Dewey (Mount Vernon Hospital, Northwood, Middx., Eng.). Intern. J. Radiation Biol., 7: 151-4(Aug. 1963).

The effect of concentration on the ability to protect bacteria under anoxic conditions against x-ray damage was studied for five different substances. Glycerol had no effect at concentrations of 10 mM and below, but at high concentrations (1 to 5 M) it was the most effective protector. Dimethylsulfoxide, like glycerol, had no effect below 10 mM; it was more effective than glycerol at intermediate concentration and less effective at high concentrations. Cysteine protected at very low concentrations but the effect fell rapidly on raising the concentration beyond 0.5 M. Mercaptoethanol behaved as though it combined the protector effect of glycerol and cysteine. Ascorbic acid behaved like cysteine at low concentrations and dimethylsulfoxide at high concentrations. (auth)

19786 SUCCINIC THIOKINASE AND SUCCINIC DEHYDROGENASE OF RHODOTORULA GRACILIS AS INFLUENCED BY TRITIATED WATER AND CYSTAMINE. G. Giovannozzi-Sermanni, I. Cacciari, and G. Di Marco (Università, Rome). Intern. J. Radiation Biol., 7: 167-72(Aug. 1963).

The effects of tritium-emitted beta radiations were tested on the succinic dehydrogenase and succinic thiokinase of Rhodotorula gracilis treated with tritiated water in the presence of different concentrations of cystamine. Under the experimental conditions, 0.65×10^{-2} M cystamine is able to counteract the alterations of succinic dehydrogenase and succinic thiokinase, while 0.65×10^{-4} M cystamine seems to protect only the succinic thiokinase. The recorded variations are related to the metabolic activity of cystamine. (auth)

19787 INFLUENCE OF β-MERCAPTOETHYLAMINE ON MUCOSAL UPTAKE OF ^{59}Fe BY INTESTINE-IRRADIATED RATS. Kedar N. Prasad and James W. Osborne

(Univ. of Iowa, Iowa City). Intern. J. Radiation Biol., 7: 245-53(Sept. 1963).

A perfusion technique was used for the study of mucosal uptake of Fe by the irradiated small intestine. The entire exteriorized jejunum and ileum were exposed to 1400 or 1800 r alone, or 1800 r preceded by mercaptoethylamine (MEA) (100 mg/kg I.P.). The decreases in mucosal uptake of ^{59}Fe were similar in the above categories for the first three days. The mucosal uptake after MEA and 1800 r was much higher at all times after day three than in animals given 1400 r alone, but on a histological basis, the intestines of both irradiated groups were similar throughout a 20-day period after irradiation. Thus there is a difference between the rate of histological and physiological recovery in the two groups. The sham-irradiated controls with MEA showed 16% mucosal uptake of Fe one day after surgery, but returned to the control level three days later. The sham-irradiated controls without MEA showed 17% mucosal uptake of Fe one day after surgery, but did not return to the control level until six days later. The animals which had the abdominal surgery necessary for perfusion maintained a 9% mucosal uptake over a 20-day period. (auth)

19788 THE RADIOPROTECTIVE EFFECT OF CYSTEAMINES. R. Huber (Deutschen Akademie der Wissenschaften, Berlin). Intern. J. Radiation Biol., 7: 311-13 (Sept. 1963). (In German)

The effects of cysteamine on survival were investigated in 20-g mice given a fractionated dose of x irradiation. Results indicated that repeated cysteamine application has radioprotective effects over a longer time. Cysteamine was administered in 0.5-ml solutions. Irradiation and cysteamine were applied at 10 to 15-min time intervals. For irradiation the animals were placed in cellulose boxes five at a time and exposed at the rate of 90 r/min. Radiation dosimetry was determined by integrated dose measurement with a 20-g mouse phantom of wet cellulose. (H.M.G.)

19789 INFLUENCE OF BETA-RADIATION WITH P^{32} ON THE HAEMIC ELEMENTS IN CHRONIC LEUKAEMIAS. P. K. Lala, B. C. Sinha, and S. B. Bhattacharjee (N.R.S. Medical Coll., Calcutta). J. Assoc. Physicians India, 10: 709-20(Dec. 1962).

Daily variation of blood counts with the accumulated dose of β radiation was studied after administration of a single dose (0.65 to 5.7 mC) of ^{32}P to 11 patients with chronic leukemia (nine chronic myeloid and two chronic lymphatic). White cell count declined to a lower level with larger doses of ^{32}P but the rate of decline per unit radiation dose was more with smaller doses. This is explained by the fact that the same amount of radiation distributed over a long interval was more effective in lowering white cell count than when applied over a short duration. There was improvement in the erythrocyte count, which was marked more at bigger doses. Maximum depressions of counts of leukemic granulocytes at five days and 35 days or more in leukemic lymphocytes suggested that the turnover time of postmitotic granulocytes was the order of a few days and that in case of postmitotic lymphocytes this was more than a month. These findings also helped in formulating therapy schedules. A dose of 0.05 to 0.1 μC/g of body weight should be followed by smaller doses at weekly intervals in chronic myeloid leukemia. But a single dose of the order of 0.75 μC/g may bring about a remission or should be repeated after a month or more in chronic lymphatic leukemia. In one case, remission was attained with a single dose of 0.75 μC/g body weight for a period of five months. In the other case a repetition of this dosage was necessary by the 35th day. It was concluded that ^{32}P does not cause general hematopoietic depression nor symptoms of radiation sickness at the doses used. (BBB)

19790 EFFECTS OF IN VIVO AND IN VITRO IRRADIATED BONE MARROW ON THE LIVER REGENERATION OF RATS. Endre Czeizel, Gyorgy Vaczo, and Pal Kertai (Országos Közegészségügyi Intézet, Budapest). Magy. Radiol., 14: 293-7(Sept. 1962). (In Hungarian)

Experiments were conducted to determine: whether irradiated bone marrow can cause the appearance of general irradiation symptoms in recipient rats; what differences can be observed in liver regeneration of rats when normal or 500-r irradiated bone marrow suspension is introduced; and whether there is any difference in the effects caused by direct irradiation of bone marrow, by in vivo irradiated bone marrow suspension obtained from irradiated animals, or by in vitro irradiated bone marrow suspension. Partial removal of the liver of 222 rats was performed, and they were x irradiated 24 hr after hepatectomy with 100, 200, 300, 400, 500, 700, and 1000 r at 67.6 r/min. In the in vivo irradiated rats, the iliac crest was shielded with Pb during the irradiation period. The in vivo irradiated bone marrow was removed from the rats 1 to 2 hr postirradiation, suspended in saline, and injected into the test animals. The in vitro irradiated bone marrow suspension was obtained from normal rats, irradiated in a test tube, and injected into test animals. The bone marrow injections were made the day after partial hepatectomy. After 100 r the mortality of rats not receiving marrow injections was 0%, regeneration of liver 2.00 g/100 g body wt, and percentage of liver regenerating 70.7%; the corresponding values at 200 r were 16.6%, 1.90 g, 65.2%; at 300 r 20%, 1.86 g, 64.3%; at 400 r 16.6%, 1.77 g, 60.5%; at 500 r 25%, 1.61 g, 62.5%; at 700 r 37.5%, 1.58 g, 61.3%; at 1000 r 50%, 1.38 g, 50.1%. The in vitro irradiated bone marrow produced a similar effect but was somewhat less effective in the percentage of regeneration. The suspension irradiated at 100, 200, and 300 r increased the regeneration process, at 400 r no effect was noted, and at greater doses regeneration was hindered. The in vivo and in vitro irradiated bone marrow suspension did not increase the mortality rate significantly. It was concluded that irradiation of bone marrow impedes the regeneration of liver in rats significantly. The beneficial effects of normal bone marrow suspension on liver regeneration are abolished when it is irradiated in vitro, except at the lower doses (100, 200, and 300 r) of radiation. (BBB)

19791 RESEARCH IN AGENTS TO PROTECT AGAINST IONIZING RADIATION. Bernard Shapiro (Albert Einstein Medical Center, Philadelphia). Med. Clin. N. Am., 48: 547-61(Mar. 1964).

Radioprotective agents are discussed from the viewpoints of: testing various agents for radioprotective effectiveness; pharmacological and toxicological studies of the effects of known protective agents; and studies on mechanism of action of known protective agents. A discussion of the leading agents, from each of the several classes of protective compounds, is provided. Mechanism of radiation protection studies of aminothiols were oriented about six major theories which are critically examined. The belief is supported that some degree of radiation protection by chemical agents will be achieved in man, but the high toxicity of most of the protective agents will probably necessitate the use of a combination of compounds and the degree of protection will not likely exceed a dose-reduction factor of two to three. (BBB)

19792 ON THE PROPHYLAXIS OF FEBRILE REACTIONS DURING RADIUM AND RADIOCOBALT INSERTIONS. H. G. Bach and F. Taeger (Universitäts-Frauenklinik, Heidelberg). Med. Klin. (Munich), 57: 1454-5(Aug. 24, 1962). (In German)

Febrile reactions impair the effectiveness of Ra and radiocobalt implants in treatment of uterine carcinoma. In order to control the febrile reactions oxytetracycline was administered intravenously to 411 patients with intrauterine inserts (300 Ra, 111 radiocobalt). In 7.5% of the cases the temperature exceeded 38°, but only in 1.2% of the cases did the temperature exceed 38.5°. Prior to the use of antibiotics it was necessary to remove the Ra implants in 12.28% of the cases. After these compounds were introduced as a prophylactic measure against febrile symptoms the cases when removal of the implant was necessary dropped to 1.3%. The percentages after intravenous antibiotic are less than those found in a previous study where an antibiotic was administered intramuscularly. It was possible to test the oxytetracylcine sensitivity of the flora in only 100 patients. In half of these cases the flora were sensitive to oxytetracycline. The percentage of patients who had Ra insertions with fever and flora sensitive to oxytetracycline in vitro amounted to only a third of those patients who had flora not sensitive to oxytetracycline or who were nonpathogenic. Prophylactic chemotherapy is a necessity with intrauterine implants of Ra or radiocobalt. No side effects were observed when oxytetracycline is used, and it has the advantage that the longer intervals between injections help to reduce the radiation hazard to medical personnel. (BBB)

19793 WAR AND MEDICINE. Robert Karsh and Malcolm L. Peterson. Nucl. Inform., 6: No. 4, 1-6(Mar. 1964).

The care of casualties in the event of radiological warfare is discussed. Three prototype cases are reviewed that stress the importance of teamwork and auxiliary services in the treatment of burns, blast injury, and radiation sickness. (C.H.)

19794 THE PROTECTIVE EFFECTS OF β-AMINOETHYLISOTHIURONIUM · Br · HBr AND p-AMINOPROPIOPHENONE AGAINST ACUTE LETHAL WHOLE-BODY X-IRRADIATION IN DOGS. John R. Newsome and R. R. Overman (Univ. of Tennessee, Memphis). Radiation Res., 21: 520-9(Apr. 1964).

In mongrel dogs, a combination of 175 mg of AET and 3.5 mg of PAPP-kg provided 100% protection in dogs exposed to 550 r of whole-body x irradiation and also protected 5 of 6 animals given 650 r. Some degree of protection at 800 r was also found. Either drug alone failed to protect dogs against 550 r, which indicates that their protective effects are additive. The drugs were administered orally in enteric-coated intermittent-release preparations 3 to 4 hr prior to irradiation. (auth)

19795 THE PROTECTIVE EFFECTS OF β-AMINOETHYLISOTHIURONIUM · Br · HBr and p-AMINOPROPIOPHENONE AGAINST ACUTE SUBLETHAL WHOLE-BODY X-IRRADIATION IN DOGS. John S. Newsome and R. R. Overman (Univ. of Tennessee, Memphis). Radiation Res., 21: 530-40(Apr. 1964).

Mongrel dogs were subjected to intermittent exposures of 265 or 200 r of whole-body x irradiation. Prior to each radiation insult, experimental animals were given AET, PAPP, or a combination of the two drugs. In the group that received 265-r exposures, dogs given both AET and PAPP tolerated an average of 3268 r per dog; those given AET and PAPP singly had averages of 1413 and 1506 r, respectively. Controls tolerated an average of 707 r each. In the animals subjected to 200 r intermittently, the average accumulated doses were 3550 r for the drug combination, 2000 r for AET, 2066 r for PAPP, and 866 r for the controls. (auth)

19796 LATE SOMATIC EFFECTS OF X-RADIATION IN MICE TREATED WITH AET AND ISOLOGOUS BONE MARROW. G. E. Cosgrove, A. C. Upton, C. C. Congdon, D. G. Doherty, K. W. Christenberry, and D. G. Gosslee (Oak Ridge National Lab., Tenn.). Radiation Res., 21: 550-74(Apr. 1964).

Young adult female (101 × C3H)F_1 mice were exposed to a sublethal or lethal x-ray dose (350 to 1800 r), with or without treatment by the radioprotective chemical S 2-aminoethylisothiuronium · Br · HBr (AET) before irradiation or isologous bone marrow (IBM) after irradiation. Sixty-day survivors were observed until death, necropsied, and examined pathologically. Irradiation shortened the life span to an extent that varied with the dose, but the degree of life shortening per roentgen decreased with increasing dose. Although AET and IBM had markedly protective effects against early lethality, their effectiveness in protecting against reduction of longevity in long-term survivors was equivocal. Sixty-six per cent of controls died with neoplasms, the most common of which arose in the ovary, lung, uterus, and breast. Ovarian and mammary tumors were more numerous in the irradiated groups, whereas pulmonary and uterine tumors were more numerous in unirradiated controls. AET and IBM were without effect on the incidence of these growths. Thymic lymphoma was increased in frequency by irradiation, as was myeloid leukemia. The incidence of other neoplasms of blood-forming elements was reduced in irradiated animals. AET and IBM inhibited the induction of thymic lymphomas. Nephrosclerosis occurred in a high percentage of heavily irradiated (>750 r) long-term survivors. The incidence was not affected by AET or IBM. Graying of the fur was noted at all radiation levels. Its severity varied with the dose and was reduced by AET. Lens opacities developed in all aging mice, including the controls. The rapidity of onset, rate of progression, and final severity of opacification increased with increasing dose of x rays. The development of opacities was not detectably affected by AET or IBM. From the results of this study, it is evident that AET and IBM protected against some but not all delayed somatic effects of whole-body x irradiation, although in no case did the protection appear to afford a factor of dose reduction approximating that obtained against the acutely lethal effects of the radiation (i.e., 40 to 50%). Further knowledge of the relation between the radiation dose and the late effects in question will be necessary before the kinds and degrees of protection afforded by AET and IBM can be defined precisely. (auth)

19797 THE RADIOPROTECTIVE EFFECT OF ANTIOXIDANTS. R. Huber (Robert-Roessle Clinic, German Academy of Sciences, Berlin). Radiobiol. Radiotherap., 4: 751-6(1963). (In German)

Antioxidants α-tocopherol, α-tocopherol acetate, and propyl gallate were examined as to their radioprotective effect on three different strains of mice. The effect was found to be dependent on the amount of the agent as well as of the strain of mice. The results show the tested antioxidants do not represent any ideal radioprotective substances. Furthermore, the solvent was found to be very important for the effectiveness of radioprotective substances. Starting from the investigations of α-tocopherol with its organic solvent the importance of the solvent is

shown especially of S-β-aminoethylisothiuronium · Br · HBr in dimethylsulfoxide solution. (auth)

19798 THE INFLUENCE OF S-β-AMINOETHYLISOTHIURONIUM · Br · HBr (AET), CYSTEAMINE (MEA) AND THIOCTIC ACID ON THE WALKER-CARCINOMA WITH FRACTIONATED LOCAL IRRADIATION. R. Huber (Robert-Roessle Clinic, German Academy of Sciences, Berlin). Radiobiol. Radiotherap., 4: 757-61(1963). (In German)

AET, MEA, and thioctic-acid given before the fractionated local irradiation of the Walker carcinoma of rats do not have any radioprotective effect. Furthermore AET and MEA seem to increase the radiation effect on the tumor. The radioprotective effect of MEA known in single irradiation is also removed with the fractionated whole-body irradiation as is shown by experiments on animals protected with MEA. Regarding the present literature the results show, that the SH-compounds AET, MEA and thioctic acid are not able to increase the radiobiological sensitivity between tumor and normal tissue as is desired in therapy. (auth)

19799 ON PROTECTIVE PROPERTIES OF DIETHYLSTILBESTROL. V. I. Suslikov (Inst. of Biology and Physics, Moscow). Radiobiologiya, 3: 880-90(1963). (In Russian)

Studies of the prophylactic effects of diethylstilbestrol (DES) as a function of total-body radiation dose showed that DES loses its potency at low doses. The mechanism of DES protective effects, related to amplified radioresistance of immunological reactions, was discussed. The maximum protective efficiency takes place at doses exceeding $LD_{50/30}$. (tr-auth)

19800 ON THE MECHANISM OF CYSTAMINE (2-AMINOETHYLDISULFIDE) RADIATION PROTECTION. E. Ya. Graevskii, M. M. Konstantinova, I. V. Nekrasova, and A. G. Tarasenko (Severtsov Inst. of Animal Morphology, Moscow). Radiobiologiya, 3: 891-7(1963). (In Russian)

The relations between the protective effects of cystamine, the oxygen content in tissues, and inhaled oxygen were studied in 8- to 12-week-old white mice weighing 18 to 20 g. Mice were injected with cystamine 15 min before exposure to 700 to 900 r of γ rays at 236 r/min. It was found that 5 mg of cystamine injected either intravenously or intraperitoneal prevented lethality after 900 r. Cystamine penetrates Erlich ascites cancer cells in approximately the same quantity in vivo and in vitro. However, its protective effects are active only in vivo. It was considered that the protective qualities of cystamine are the products of its transformation in the organism into cysteamine. (R.V.J.)

19801 CONCENTRATION OF FREE OXYGEN IN THE BRAIN AND BONE MARROW IN RABBITS DURING CHEMICAL PROTECTION AGAINST IONIZING RADIATION. N. I. Bicheikina. Radiobiologiya, 3: 898-902(1963). (In Russian)

Intravenous injections of 400 mg/kg of L-cysteine, 150 mg/kg of β-mercaptopropylamine (MPA), 125 mg/kg of β-mercaptoethylamine (MEA), 30 mg/kg of sodium nitrate, and 30 mg/kg of paraaminopropiophenone reduced a relative concentration of free oxygen in the brains of rabbits. Introduction of sodium nitrate into the tibia marrow induced a prolonged reduction of the relative free oxygen balance. Injections of L-cysteine, MPA, and paraaminopropiophenone did not affect the oxygen content in the marrow. (R.V.J.)

19802 SOME THOUGHTS ON THE TIME FACTOR. Carl F. Von Essen (Yale Univ., New Haven). Radiol. Clin., 33: 28-33(1964).

An attempt is made to synthesize some concepts developed from recent survival studies with some problems related to clinical radiotherapy. It is possible that normal tissue and its malignant counterparts may not differ significantly in cellular reproductive death following single doses of irradiation. However, considering the milieu of the tumor and its host tissue, protraction of radiation dosage may exploit at least one repair mechanism uniquely advantageous to the host: the ability of normal tissue to repopulate the damaged site from surrounding unirradiated areas. (auth)

19803 THE INFLUENCE OF A NEW ANTIPHLOGISTIC ON REACTION TO RADIATION. R. Fridrich (Buergerspital, Basel). Schweiz. Med. Wochschr., 93: 1634-5 (Nov. 16, 1963). (In German)

In order to prevent submucosal tissue injuries from radiation, a pyrazole derivative, oxyphenylbutazone (Tanderil), was tested for its antiphlogistic effect. A total of 50 patients with carcinomas of the larynx or pharynx were irradiated at a rate of 60 r/min from a ^{60}Co source. The mean daily dose ranged up to 240 r, and the maximum daily dose was 300 r. The radiation was administered for as long as 50 days. Half of the patients received from 0.4 to 0.6 g of Tanderil orally each day, along with a vitamin supplement. Half of the patients received only the vitamins. The criterion for comparison of the effects was the complete appearance of mucosal skin reactions. The medication did not prevent appearance of these symptoms, but it delayed them. The relation between the height of the mean dose and the appearance of the symptoms was constant. Statistical analysis showed that the threshold value for the reactions was increased. Glottal edema is not observed when the medication is used. The subjective complaints of the patients are decreased even though the symptoms often appear. For this reason it is easier to administer the intended dose of radiation within the time selected. The medication seemed to increase general tissue resistance to mucosal reactions, but whether this is related to the effect on the tumor in any way remains to be investigated. Results obtained so far do not suggest that there is increased tumor resistance. Side effects were not observed, and changes in the blood picture and digestive complaints are no greater than in untreated patients. This drug is given prophylactically in all cases where there is any possibility of a mucosal skin reaction. (BBB)

19804 ON THE INFLUENCE OF ANEMIC BLOOD PLASMA ON THE EFFECTIVENESS OF BONE MARROW TRANSPLANTATION IN ACUTE RADIATION SICKNESS. Dimiter G. Zographov and Ilia A. Baev (Radiobiologische Forschungsinstitut, Sofia). Strahlentherapie, 123: 254-8 (Feb. 1964). (In German)

Preliminary results concerning the influence of the anemic blood plasma upon the effect of bone marrow transplantation after irradiation are reported. It was found that plasma of rabbits treated with phenylhydrazine increased the survival rate of x-irradiated white male rats (LD 95) after a homologous bone marrow transplantation from 40 to 65% ($p = 0.02$), if the plasma was used at the 4th, 6th, and 7th day after irradiation. The plasma of normal rabbits did not show this effect. It was concluded that the change in survival time is probably caused by the effect of erythropoietin upon the erythropoietic potential of the receiver which was increased after transplantation. (auth)

19805 ESTIMATION IN VIVO OF THE VIABILITY OF FROZEN AND STORED BONE MARROW. A. J. S. Davies, J. H. L. Playfair, and A. M. Cross (Royal Cancer Hospital, London and Royal Marsden Hospital, London). Transplantation, 2: 261-70(Mar. 1964).

The loss of viability of frozen mouse bone marrow was estimated in three ways after injection into irradiated mice: by determination of its potential as a therapeutic agent in affecting survival; by determination of its capacity to restore various peripheral blood components towards normal; and by determination of its capacity to give rise to spleen spots. These estimates are compared and discussed. Freezing was found to diminish the therapeutic potential by 90%, the capacity to restore peripheral blood components by 50% (little difference between the various components was observed), and the potential for giving rise to spleen spots by 50%. The possibility that frozen marrow may not be able to effect hematopoiesis at normal levels for more than about 10 days is considered. (auth)

19806 THE EFFECT OF INSULIN ON OXYGEN CONSUMPTION AND ON SURVIVAL OF X IRRADIATED RATS. S. P. Vlasenko. Vopr. Radiobiol., Akad. Nauk Arm. SSR, Sektor Radiobiol., Sb. Tr., 2: 189-94(1961). (In Russian)

The experimental data show that a total irradiation of rats with an x-ray dose of 750 r, causes a continuous suppression of gas exchange. A multiple insulin injection (0.5 units/kg) of nonirradiated rats simultaneously reduces both sugar content in the blood and consumption of oxygen. The similar phenomena are also observed when preliminary irradiated rats are subject to a multiple insulin injection. Insulin is also found neither to relieve the course of radiation sickness nor to increase the rate of survival of the irradiated rats. (auth)

19807 THE ROLE OF RUTIN AND ATP FOR RADIATION PROTECTION OF THE LUNGS. EXPERIMENTAL STUDIES WITH RATS. D. Lemanczyk. Thesis, Tübingen, Ger., Universität, 1963. 61p. $2.00(Gmelin, AED-DISS. 63-316). (In German)

Radiation effects in rat lungs after irradiation with 2000 r, ^{60}Co γ rays are studied. The first reaction, which was roentgenologically detectable, was observed 31 days after irradiation. All animals were sacrificed after 45 days. Results of histological studies of lung tissue are given. Protective action of rutin and ATP is investigated. Results indicate a marked protective effect of rutine for lung tissue. No action of ATP was observed. (Gmelin Inst.)

19808 USE OF A RADIATION RESISTANT ORGANISM AS A PROTECTANT FROM LETHAL EFFECTS OF IRRADIATION IN MICE. Joan Priscilla Payne Kilbourn. Thesis, Corvallis, Ore., Oregon State Univ., 1963. 218p.

Whole bacterial cells of high radiation resistance were injected into mice that were subjected to a lethal dose of irradiation. It was observed that cells injected into the peritoneal cavity of mice before or after irradiation protected some of them from a lethal dose of irradiation. The effect of extracts from the cells was then examined. The cytoplasmic and particulate material was isolated from R1 by sonication of whole cells and these were tested for their protective efficacy. Though both fraction protected mice from the lethal effects of radiation the particulate material gave better results. Cellular extracts of pigment material were examined for their protective ability as well as various other cellular extracted material. The sulfuric acid or petroleum ether extracted cellular material gave the best results. Miescher's method for isolating nuclear material yielded material that was the most effective radiation protective material of the nuclear materials tested. Even though the nuclear material prepared by Miescher's method was crude, containing associated lipid, pigment and protein material, chemical analysis was performed. The results indicated more sulfur than expected. The crude nuclear material was purified further by separating the lipid-pigment material from it. The lipid-pigment material of the nucleic acid extracted material appeared to be the protective fraction rather than the nucleic acid material. When purified still further by saponification or when the methyl derivative was prepared, the lipid portion had more protective properties than the pigment material. The pigment-lipid material was also crudely separated on a silicic acid column and the first fractions that were removed (neutral fats and bound lipids) appeared to be the protective portion. (Dissertation Abstr., 24: No. 9, March 1964)

Radiation Hazards and Protection

19809 RADIOACTIVITY IN MILK. Ernst Knopp. Milchwissenschaft, 18: 17-20(1963). (In German)

Studies on the contamination of milk with ^{90}Sr, ^{137}Cs, and ^{131}I carried out in the German Federal Republic from September 1961 to September 1962 are described. It was found that ^{90}Sr and ^{137}Cs did not reach the maximum tolerance, whereas ^{131}I exceeded it during a short period of time. It was also found that gamma spectrometry measurements of ^{137}Cs, which may be completed in a few hours, allow the ^{90}Sr content in milk to be estimated with sufficient accuracy. (auth)

19810 RADIOACTIVE IODINE IN FRESH VEGETABLES. G. Kistner (Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Ger.). Naturwissenschaften, 51: 109(1964). (In German)

Measurements were made of the ^{131}I content of vegetables in the fall of 1962. Head lettuce, endive, brussels sprout, and lamb's lettuce were analyzed for ^{131}I. Activities between 0 and 1067 pC/kg were found in the samples investigated. (M.C.G.)

19811 REPORT ON THE DEVELOPMENTS FOR DOSIMETRY OF FAST ELECTRONS. PART I. DOSE CONCEPTS AND THEIR REALIZATION. Benno Markus (Universität, Göttingen, Ger.). Strahlentherapie, 123: 350-65(Mar. 1964). (In German)

Current knowledge on the dosimetry of fast electrons is reviewed. Definitions of absorbed dose, energy dose, and specific dose are presented. Some methods for absolute and relative dose measurements are discussed. Some calculations for determination of the absolute dose according to the Bragg-Gray principle are presented. (M.C.G.)

Radiotherapy and Radiodiagnosis

Refer also to abstracts 20254, 20263, 20264, and 20416.

19812 (BNL-6966) RESPONSES OF NORMAL AND MALIGNANT MAMMALIAN TISSUE TO BOMBARDMENT WITH HIGH-ENERGY PROTONS. John E. Jesseph, Stuart W. Lippincott, William H. Moore, Jr., and Victor P. Bond (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT(30-2)-Gen-16. 10p.

The high-energy proton beam of the Brookhaven proton

synchrotron (Cosmotron) is under study with regard to the fundamental, elemental tissue and organ responses of mammals to this form of energy transfer. Lethality for small animals, and in vivo activation of light elements were preliminarily characterized and their usefulness estimated. Physical studies including dosimetry and distribution of particles within the proton beam are intended to improve understanding of distribution of proton dose. Such understanding is critical to interpretation of any experimental result. The determination of the boundaries of application of accelerator-produced particles of these energies to neoplastic lesions is part of our continuing study. (auth)

19813 (CONF-164-11) COLLOIDAL RADIOALBUMIN AGGREGATES FOR ORGAN SCANNING. George V. Taplin, Earl K. Dore, DeLores E. Johnson, and Harriet Kaplan (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology and Los Angeles County Harbor General Hospital, Torrance, Calif.). [1963]. Contract AT-04-1-GEN-12. 9p.

From Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963.

Colloidal aggregates (10 to 20 mμ) of human serum albumin ^{131}I may be used safely by intravenous injection to perform photoscans of the heart, liver, spleen, stomach, and salivary glands in man. Large particle size suspensions (10 to 50 μ) of the same material were investigated experimentally in animals for scanning the lungs after intravenous injection and the brain following injection into an internal carotid artery. The advantages of this test material are the relatively low radiation exposure to the target organs and the number of organs that may be examined. Radiation exposure is low because of the rapid turnover in the target organs and removal from the body, mainly by urinary excretion, within 72 hr. The mechanism of liver-spleen localization with this organic colloid is the same as for inorganic colloidal ^{198}Au, namely, rapid removal from the blood by the phagocytic cells of the liver and spleen. However, in contrast to the inorganic colloid, which remains in the phagocytic cells permanently, albumin is digested by proteolytic enzymes and the ^{131}I label is set free to re-enter the general circulation. With the thyroid blocked, the ^{131}I is excreted mainly in the urine as free iodide together with other labeled albumin degradation products, such as tyrosine and peptides. The calculated radiation dose to the liver is at least 100 times less from colloidal albumin ^{131}I than from an equal dose of ^{198}Au. (auth)

19814 (CONF-453-1) THE USE OF Tc^{99m} AS PERTECHNETATE FOR THYROID LIVER AND BRAIN SCANNING. Paul V. Harper, Katherine A. Lathrop, Robert J. McCardle, and George Andros (Argonne Cancer Research Hospital, Chicago and Chicago. Univ. Hospitals and Clinics). [1963]. Contract [AT(11-1)-69]. 7p. (SM-51/50)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Technetium-99m has physical characteristics that make it useful for a wide variety of tracer studies in man, including scanning of the thyroid, brain, liver, and kidneys and studies of ion trapping by the thyroid. It has a special use in children where radiation damage is more critical than in adults. (C.H.)

19815 (NP-13856) CLINICAL DOSIMETRY. Recommendations of the International Commission on Radiological Units and Measurements (1962). ICRU Report 10d. (National Bureau of Standards, Washington, D. C.). Aug. 9, 1963. 61p. (NBS-Handbook-87)

Recommendations are presented which were agreed upon at the ICRU meeting held in Montreux, Switzerland, in April 1962. These recommendations cover radiotherapy and good radiotherapeutic techniques. Among the items treated are concepts and units, definition of terms, calibration and central ray dose determination, isodose charts for single fields, moving field therapy, dose distributions in the patient for both fixed-field and moving-field therapy, recording and reporting, and error sources. (D.L.C.)

19816 A THEORETICAL MODEL FOR THE STUDY OF NEUTRON EFFECTS ON TUMORS. G. Silini and R. G. Miller (Stanford Univ., Palo Alto, Calif.). Ann. N. Y. Acad. Sci., 114: 60-84(Mar. 31, 1964).

Aspects of neutron radiotherapy for tumors are presented from an entirely theoretical point of view. A model is proposed assuming: loss of reproductive integrity is some portion of the tumor mass; limitation of the effects to a specific tumor mass; exhibition by the tumor cells of a multihit survival curve; continuation past the survival curve shoulder in an indefinite exponential trend; interpretation of recovery as damage recuperation at the cellular level; application of observed irradiated phenomena in free cells to tumor masses; time intervals between radiation doses sufficient for maximum possible recovery; and a recovery rate independent of linear energy transfer. From a purely theoretical analysis and in the absence of experimental data on the subject, it was impossible to make predictions of immediate practical value. It seemed possible to anticipate, however, that necrotic tumors with an insufficient blood supply would be particularly responsive to neutron treatment. In special cases, when the state of oxygenation of the cells may be thought to improve during fractionated therapy, a mixed treatment could also be considered. (H.M.G.)

19817 SCANNING WITH POSITRON-EMITTING RADIOISOTOPES: OCCLUSIVE CEREBRAL VASCULAR DISEASE. Robert G. Ojemann, Saul A. Aronow, and William H. Sweet (Massachusetts General Hospital, Boston). Arch. Neurol., 10: 218-28(Feb. 1964).

An evaluation is made of the use of ^{74}As and ^{64}Cu for the detection of ischemic brain lesions. Evaluation of scans of patients with intracranial tumors has shown that As is somewhat superior to Cu chelates in the localization of these lesions. This superiority was even more evident in vascular lesions, but the reasons for pursuing the use of Cu are its ready availability from the reactor, lower cost, and its short half life (12.8 hr) which allows a reduced radiation dose and more frequent serial scans. Data from 146 patients with occlusive cerebral vascular disease were analyzed and correlated with the radioisotopic scan. The accuracy of localization was verified by the pathologic studies. Correlation of the interval from onset of symptoms to time of the scan reveals a decreasing percentage of definitely abnormal studies with time. Patients with transient ischemic attacks or in whom the neurologic deficit is temporary usually show normal scans. In no case of infraction due to cerebral embolism was a positive scan found. The radioisotopic scan may be a useful guide in predicting the prognosis following a cerebral infraction or in evaluating patients who are being considered for surgery of extracranial occlusive disease. (BBB)

19818 TOTAL BODY SCANNING. J. S. Laughlin, D. A. Weber, P. J. Kenny, K. R. Corey, and E. Greenberg (Sloan-Kettering Inst. for Cancer Research, New York). Brit. J. Radiol., 37: 287-96(Apr. 1964).

A high energy γ-ray scanning system was described which was applied to locating areas of increased concen-

tration of γ-emitting isotopes in the body, and also to the measurement of retention of an administered isotope. The localization feature of this scanner was useful in the finding of lesions in the body and in studies of the metabolic behavior of these lesions as a function of time, and as a function of the administration of either drugs or radiation. The total-body counting feature of this scanner proved to be an effective and much more simple alternative to the collections of urines and stools in the determination of total-body retention. (auth)

19819 A 24 CURIE STRONTIUM 90 UNIT FOR WHOLE-BODY SUPERFICIAL IRRADIATION WITH BETA RAYS. J. L. Haybittle (Addenbrooke's Hospital, Cambridge, Eng.). Brit. J. Radiol., 37: 297-301(Apr. 1964).

The design and construction of a 24-C $^{90}Sr-^{90}Y$ unit for whole-body superficial irradiation are described and the results of dosage measurements reported. The effective half-value thickness of the β-ray beam is 2 mm, and a dose of 200 rads can be delivered to an area 188 cm long by 53 cm wide in a time of about 18 min. Shorter lengths of the body can be treated in correspondingly shorter times. (auth)

19820 LARGE-FIELD SUPERFICIAL ELECTRON THERAPY WITH LINEAR ACCELERATORS. C. J. Karzmark (Stanford Univ., Palo Alto, Calif.). Brit. J. Radiol., 37: 302-5(Apr. 1964).

An electron therapy technique is described for treating large field superficial lesions, particularly mycosis fungoides. An x-ray linear accelerator was modified to permit convenient, rapid, and routine conversion to this treatment modality with minimum interference to a large supervoltage therapy program. Information is presented on treatment geometry, electron x-ray conversion features, dosimetry, and treatment planning. The system can be adapted to different accelerators, although it lends itself particularly well to the isocentric geometry found on many linacs, and results similar to those described would probably be obtained with existing 4 Mev equipments. The use of carbon decelerator-scatterers could extend the technique to somewhat higher energy accelerators as well as permitting a wider choice of depth dose characteristics. (auth)

19821 A FAST NEUTRON SOURCE FOR RADIOTHERAPY. D. Greene (Christie Hospital, Manchester, Eng. and Holt Radium Inst., Manchester, Eng.). Nature, 202: 204-5(Apr. 11, 1964).

A collimator designed for 14-Mev neutrons is described. An experimental steel collimator 16-in. thick was set up, and the intensity distibution across one edge was determined. It was found that the intensity outside the beam is about 4% of that inside. Attenuation values for paraffin, lead, brass, steel, and polythene are given. The results show that an adequately thick collimator of steel will permit treatments at a distance of 50 cm from the source. (P.C.H.)

19822 COMPARATIVE EXAMINATIONS ABOUT THE STATEMENT OF THE EARLY UPTAKE-MEASUREMENTS AND ABOUT THE RADIATION DOSE IN THE RADIOIODINE TEST. H. J. Correns, E. Dressler, and H. Fickel (Medizinischen Universitäts-Poliklinik, Jena, Ger.). Radiobiol. Radiotherap., 4: 717-26(1963). (In German)

From the results of the examination of 1438 patients the results of the early uptake measurement of the whole diagnosis consisting of two-phase test and clinical preliminary examination were opposed. The early uptake measurement only conditionally permits a judgment of the functional state in the iodine metabolism. False diagnoses especially within the group of euthyroidism, hyperthyroidism, and compensated hyperplasia occur in about 40% of all cases. Therapeutic injuries from such false diagnoses should be pointed out. After it was possible to decrease the tracer dose in the radioiodine two-phase test by means of technical improvements to 3 μC the radiation dose in the two-phase test in the thyroid gland is only about the threefold and the dose to body and gonads on the other hand is three times less than in the rapid test with ^{132}I. The conclusion follows that the radioiodine two-phase test with ^{131}I with low radiation dose to the gonads is superior to the rapid test. (auth)

19823 DIAGNOSIS OF TUMORS OF THE EYE WITH RADIOACTIVE PHOSPHORUS. H. J. Correns, E. Dressler, and A. Juette (Universität, Jena, Ger.). Radiobiol. Radiotherap., 4: 727-32(1963). (In German)

An increase of radioactivity may be measured in the main only directly over the tumor. Tumors on the posterior pole of the eye may therefore be measured with suitable counters only, in the best way following the operative incision of the conjunctiva. In the indication of the radiophosphorus test the high radiation dose to the patient is to be considered. The procedure offers a high significance and is a valuable completion of the remaining method of diagnosing tumors of the eye. (auth)

19824 OPTIMUM DISTRIBUTION OF Y^{90}-SEEDS IN RADIATION HYPOPHYSECTOMY. K. Dvořák (Charles Univ., Hradec Kralove, Czechoslovakia). Radiobiol. Radiotherap., 4: 733-7(1963). (In German)

Four types of distribution of ^{90}Y in radiation hypophysectomy as well as advantages and disadvantages of the individual types of radiator application were discussed. From experiences and possibilities the implantation of about five ^{90}Y-seeds with a total activity of 6 to 8 mC was considered to be the best. Under these conditions a complete destruction of the hypophysis may be achieved and a good success of the operation may be expected. (auth)

19825 THE ABSOLUTE MEASUREMENT OF THE R-UNIT IN THE RANGE OF BORDER-RAYS — THE WILHELMY-CHAMBER OF THE INSTITUTE OF BIOPHYSICS, BERLIN-BUCH. A. Rakow and W. Will (Inst. of Biophysics, German Academy of Sciences, Berlin). Radiobiol. Radiotherap., 4: 739-44(1963). (In German)

According to definition, the reproduction of the r-unit in the range of border rays is possible by means of a free air ionization chamber in which the radiation enters the chamber through a diaphragm that defines the radiation cross section and will be entirely absorbed within the measuring volume. A standard measuring equipment operating in accordance with this principle is described. Corrections of these measuring results will be given and the margins of error of the dose measurement estimated. (auth)

19826 THE ABSOLUTE MEASUREMENT OF THE R-UNIT IN THE ENERGY RANGE OF CONVENTIONAL X-RAY THERAPY. THE PRIMARY STANDARD X-RAY IONIZATION CHAMBER OF THE DAW-INSTITUTE OF BIOPHYSICS, BERLIN-BUCH. A. Rakow and J. Richter (Inst. of Biophysics, German Academy of Sciences, Berlin). Radiobiol. Radiotherap., 4: 745-50(1963). (In German)

The primary standard x-ray ionization chamber assembly designed in the Institute of Biophysics of the Deutsche Akademie der Wissenschaften is described. The necessary correction factors and their determination and the partly experimentally partly numerically determined deviations of different standard chambers are reported. The maximum error in the reproduction of the R-unit with this assembly is ±1.8%, the mean deviation ±1.5%. (auth)

19827 CARCINOMA OF THE URINARY BLADDER. Clifford V. Allen (Univ. of Oregon, Portland). Radiol. Clin., 33: 7-12(1964).

Sixty-four cases of urinary bladder carcinoma were treated with ^{60}Co teletherapy or 2-Mev Van De Graaff generator x radiation using doses of 6,500 to 7,000 r when tolerated. Complications were few and of minor nature, with excellent toleration of radiation in most instances. When radiation failed to control neoplasm, cystectomy could be carried out if ureteral anastomosis was performed on unirradiated portions of the ureter. Observation of cases from one to 28 months indicates an apparent 40% cure rate with radiation therapy only, and some of the failures could be salvaged surgically. (auth)

19828 THE MAGIC 6,000. John C. Evans (Albert Einstein Coll. of Medicine, New York). Radiol. Clin., 33: 34-8 (1964).

A monotonous similarity in recommended tumor dose in curative and palliative radiotherapy is seen in recent publications. The possibility that maximal benefit to the patient may not require a dose equal to or exceeding normal soft tissue tolerance is considered. This is illustrated by clinical impressions in two problems: curative irradiation of endometrial carcinoma and palliative irradiation of bone metastasis from breast cancer. (auth)

19829 EXPOSURE CONTROL IN CINERADIOGRAPHY. John A. Campbell, John P. Tampas, and Donald D. Gray (Indiana Univ., Bloomington). Radiology, 82: 704-9(Apr. 1964).

A semiautomatic exposure-control meter circuiting is described, which may be used on either a manually or automatically operated x-ray generator to assure proper pre-exhibition of cine exposure technique. When utilized with an automatic brightness-stabilization circuit, the exposure-control meter serves the important additional function of assuring that the phototube signal to the generator control is adequate to achieve the proper intensity for correct film exposure. The exposure meter adaptation may be switched to manual operation at any time if the automatic stabilizing circuit fails to balance properly. Two major limitations of the exposure control system are described that prevent its being completely automatic in function: it must be individually calibrated with the predetermined light response of the phototube, the film-emulsion speed, the framing rate, the camera aperture, and the processing method; and no mechanical or electrical compensating device is provided to adjust the sensitivity of the phototube to the varying intensities of light emerging from the output screen of the image tube with the changes in field size during fluoroscopic collimation. Further research is needed to develop a fully automatic photoscanning device for cine exposure control. (auth)

19830 TECHNICAL ASPECTS OF THE PRETORIA APPROACH TO THE USE OF RADIUM IN THE TREATMENT OF CANCER OF THE UTERUS. D. J. Savage and J. C. B. Millin (Pretoria General Hospital). S. African Med. J., 37: 703-7(July 6, 1963).

A new Ra applicator and modified methods for irradiation of uterine carcinoma are described. The construction of these applicators, the dosage distribution around them, and the radiation safety measures that are adopted when they are used are also described. Isodose curves were obtained by the summation of contributions from each tube at a number of points, and dosage distributions resulting from a 72-hr exposure with Ra tubes having 0.5 mm Pt filtration and active length 13.5 mm are shown. Protective devices used in the Ra loading room and wards are also described and illustrated. (BBB)

19831 A METHOD OF CALCULATION OF THE DOSE DISTRIBUTION WITH DIGITAL COMPUTER. Juergen Richter and Dieter Schirrmeister (Robert-Rossle-Klinik, Berlin). Strahlentherapie, 123: 45-58(Jan. 1964). (In German)

A procedure for calculating the dose distribution for any body shape during pendulum and rotational irradiation with ^{60}Co using a digital computer is described. Contrary to the literature published previously the computer is not used for the calculation of standard fixed field isodoses only; the calculation of the depth dose values rather is part of the program for the determination of the dose distribution. Field parameters can be chosen at random. (auth)

19832 ON THE USEFULNESS OF RADIATION-PROTECTION PASTES FOR USE IN WEAK RADIOTHERAPY. Wilhelm Lessel and Gerhard Reichel (Strahlentherapeutische Klinik, Medizinische Akademie, Magdeburg, Ger.). Strahlentherapie, 123: 59-63(Jan. 1964 (In German)

Investigations proved that radiation protection pastes are very suitable for a protective covering of healthy skin areas. While zinc and barium pastes can be recommended for very weak radiation qualities only, lead and bismuth pastes applied in a thickness of 1 to 2 mm offer almost complete protection against radiation up to 70 kv. (auth)

19833 THE IMPORTANCE OF THE PENUMBRA FOR SMALL SQUARE AND CIRCULAR IRRADIATION FIELDS. Manfred Busch (Medizinische Universität Sklinik Freiburg i. B.). Strahlentherapie, 123: 373-80(Mar. 1964). (In German)

The influence of geometrical penumbra on the shape of small irradiation fields was investigated by means of a computer. Special considerations were given to the ^{60}Co unit. Maximal deviations in radiation intensity for identical square fields lying normally and diagonally to the irradiation beam compared to circular fields were determined. There was almost no difference in the geometrical dose distribution between square and circular fields if a field size of 1 cm^2, a source diameter of 15 mm, a source-skin distance of 60 cm, and a source-diaphragm of 30 cm were used. A maximal deviation of 2.4% was obtained at smallest skin surface areas. Thus, in case of cobalt-distant irradiation, larger rectangular fields could be assembled by circular fields of 1 cm^2. (auth)

19834 LIVER SCANNING WITH RADIOMOLYBDENUM. Leif B. Sorensen (Univ. of Chicago). 16p. (CONF-453-3)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Methods and results of liver scanning with the use of ^{99}Mo as the tracer are described. It is pointed out that ^{99}Mo has a number of advantages over tracers previously used in liver scanning. (C.H.)

19835 TECHNIQUES WHICH AID IN QUANTITATIVE INTERPRETATION OF SCAN DATA. Donald B. Charleston, Robert N. Beck, Paul Eidelberg, and Mark W. Schuh (Univ. of Chicago). 20p. (CONF-453-5)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

Auxiliary equipment and techniques for data analysis for use with radiation-scanning systems are evaluated. Emphasis is placed on equipment for use with a brain-scanning system for tumor localization. It is pointed out that, while digital techniques offer accurate records of scan data, the computer techniques for manipulating the data are quite complex. Analog techniques are less accurate, in the sense that the numerical data are lost, but offer a wider range of simple convenient manipulative procedures. (C.H.)

CHEMISTRY

General

Refer also to abstracts 20676 and 21661.

19836 (EUR-496.f) CALOPORTEURS ORGANIQUES D'ORIGINE PETROLIERE POUR REACTEURS NUCLEAIRES. (Petroleum-Based Organic Coolants for Nuclear Reactors). G. P. de Gaudemaris, E. de Gorski, P. Giuliani, and G. Leleu (Institut Francais du Petrole des Carburants et Lubrifiants, Paris). 1964. 19p. (CONF-477-1)

From 6th World Petroleum Congress, Frankfurt am Main, June 1963.

Of all the various "strings" now being studied with a view to the utilization of the energy obtained from the fission of uranium, those known as organic strings are perhaps the most common. These are nuclear reactors in which an organic liquid, known as the coolant, is used to remove the heat calories set up in the nuclear fuel and in certain circumstances also to slow down the neutrons and make them more suitable for capture by the uranium nucleus, in which case they are called moderators. In certain reactor types, the organic liquid fulfils two functions, while in others it merely acts as a coolant, heavy water then being used as the moderator. It is this latter type which is being developed in Europe by Euratom. In systems of this type, the organic liquid must be subjected to a very high temperature (375 to 450°C) and also to a considerable radiation flux (several watt/gram), so that there are very few organic molecules which can withstand such conditions. Hitherto the use of polyphenyls has been advocated, but although they are fairly satisfactory, their excessively high solidification point constitutes a certain technological drawback. Also the cost, which is still fairly high, restricts their use, for consumption runs to several grams per kwh of electrical energy produced, owing in particular to radiolysis. Under a contact concluded with Euratom (ORGEL Program), the Institut Français du Pétrole (French Petroleum Institute) has carried out studies on the various aromatic petroleum cuts which the oil industry can supply cheaply. On the basis of their thermal and radiolytic stability, the "alkyl phenanthrene" cuts extracted from the power-forming residue were chosen as the most suitable. By virtue of their origin, these cuts have the advantage of being completely free from impurities and entirely aromatic. Their radiolytic stability is excellent, being better than that of the terphenyls. Their thermal stability, which is less satisfactory, must be improved by additional refining. The preparation, purification, characteristics, and detailed composition of these cuts are outlined together with their behavior during high-temperature irradiation tests in a loop installed in the Mélusine pile at the Grenoble Centre d'Etudes Nucléaires. (auth)

19837 (MIT-905-1) PROGRESS REPORT [ON NUCLEAR SCIENCE]. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [1963]. Contract AT (30-1)-905. 138p.

Research activities in the field of nuclear chemistry and chemistry of the fission elements are reported. A statement of expenses for the current term and proposed budget for the coming year are given. (N.W.R.)

19838 (UJV-909/63) ION EXCHANGERS, CONTAINING PHOSPHORUS OR ARSENIC IN THEIR FUNCTIONAL GROUPS. PART I. ORGANIC ION EXCHANGERS. M. Marhol (Československá Akademie Věd. Ústav Jaderného Výzkumu, Rež). [1963].

A review is presented of the synthesis and possible use of ion exchangers comprising phosphorus and arsenic. References are given on the synthesis of various types of both cation and anion exchangers. The properties and results obtained with the use of these ion exchangers in practice up to present are also given. (auth)

Analytical Procedures

Refer also to abstracts 20217 and 20430.

19839 (BM-RI-6430) SEPARATION AND DETERMINATION OF RARE EARTH METALS IN ZIRCONIUM–RARE EARTH ALLOYS. Edward Cogan (Bureau of Mines, Washington, D. C.). 1964. 9p.

Equilibrium phase diagram studies of zirconium-rare earth metal alloys prompted the development of a rapid gravimetric method for determining rare earths in zirconium in which the rare earths are absorbed from sulfuric acid solution of the alloy on a cation exchange resin. The sample in 10 percent H_2SO_4 is introduced into the column, the zirconium is eluted with 10 percent H_2SO_4, and the rare earths are eluted with $(NH_4)_2SO_4$ solution and precipitated with NH_4OH. A tracer technique was employed to determine the efficiency of the procedure. Y_2O_3 and europium-154 and -152 (Oak Ridge) were added to 10 g of zirconium and taken through the entire procedure. Recovery averaged 97.6 percent on 0.002 μg europium in the rare earth fraction. Rare earths were determined in the range 0.10 to 90 percent. (auth)

19840 (CEA-R-2419) ISOLEMENT D'UN TRACEUR POUR L-ANALYSE RADIOCHIMIQUE DU RADIUM 226. (The Separation of a Tracer for the Radiochemical Analysis of Radium 226). Michel Butaye (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Mar. 1964. 7p.

A description is given of a radiochemical method of separation of ^{223}Ra from an uranium ore and its use for the analysis of ^{226}Ra. (auth)

19841 (CONF-187-112) SODIUM SEPARATION FROM BIOLOGICAL MATERIAL. N. Spronk (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 8p.

From the American Nuclear Society Meeting, New York, Nov. 1963.

Procedures are described for the determination of trace amounts of Na in biological materials by separation on an anion resin column, neutron activation, and γ spectroscopy. Problems caused by interference between ^{24}Na and ^{64}Cu are discussed. Applications in studies of trace element physiology of fresh water snails are reported. (C.H.)

19842 (EUR-581.f) DETERMINATION DE LA TENEUR EN COBALT D'UNE SOLUTION PAR SPECTROPHOTOMETRIE DIFFERENTIELLE. (Determination of the Cobalt Content of a Solution by Means of Differential Spectrophotometry). A. Brueck, K. F. Lauer, and Y. Le Duigou (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. Central Nuclear Measurements Bureau, Geel, Belgium). 1964. 8p.

Differential spectrophotometric measurements are made

of the coloration of two solutions differing in their cobalt content by about 55 μg. The standard colorimetric procedure with ammonium thiocyanate as reagent is used. The calibration factor can be measured with a precision of ±0.77%. Depending on the number of measurements made very good precision is obtained. The statistical treatment of the results reported for 50 mg cobalt sample gives a standard deviation on the mean value (95% confidence level) of about 0.06 to 0.1%. The absolute value of course depends on the precision and accuracy with which standard cobalt solutions can be prepared. The method can be applied to other cobalt contents using a calibration factor based on the corresponding new reference solutions. (auth)

19843 (IS-658) SPECTROPHOTOMETRIC DETERMINATION OF PERCHLORATE. James S. Fritz and Patricia A. Campbell (Ames Lab., Ames, Iowa). [May 10, 1963]. Contract [W-7405-eng-82]. 14p.

Perchlorate is extracted from aqueous solution by n-butyronitrile as ferrous 1, 10-phenanthroline perchlorate. The amount of perchlorate is calculated from spectrophotometric measurement of the absorbance of the extract. Moderate to large amounts of chloride, sulfate, or nitrate cause little or no interference. Chlorate is slightly extracted but the interference can be corrected. (auth)

19844 (ISPRA-455) LE DOSAGE DES TRACES MINERALES DANS LES POLYPHÉNYLES PAR SPECTROGRAPHIE X. (Determination of Trace Minerals in Polyphenyls by X Spectrography). G. Vos (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). May 1963. 27p. (CONF-435-2)

From the 25th Annual Congress of the Group for Advancement of Spectroscopic Methods, Paris, June 1963.

A large number of elements such as Zr, U, Fe, Cr, Ni, Mn, Co, Cu, Zn, Ca, S, P, Cl can be determined in polyphenyls by x spectrography. Detection limits extend from some 10 ppm for the elements between Ca and U, up to some ppm for the lighter elements, i.e., P, S, and Cl. However, the use of new conditions of analysis ought to improve these latter values. (auth)

19845 (JAERI-1053) ANALYSIS OF VARIOUS KINDS OF URANIUM-BASE ALLOYS USING EXTRACTION-PHOTOMETRIC METHOD. 8-QUINOLINOL, 2-METHYL-8-QUINOLINOL AND DIMETHYLGLYOXIME EXTRACTION-PHOTOMETRIC METHOD. Hiroshi Hashitani (Japan Atomic Energy Research Inst., Tokyo). Oct. 1963. 20p.

In the determination of the additive elements in uranium alloys, the extraction-photometric method was adopted and the following reagents were used: 8-quinolinol for aluminum, iron, molybdenum, niobium, and vanadium; 2-methyl-8-quinolinol for chromium and titanium; and dimethylglyoxime for nickel. In each case, masking agent for uranium, optimum pH range for extraction, washing of the extract, and the wavelength of absorbance measurement were closely studied. The reproducibility and the accuracy of all the methods were satisfactory, and some of the methods have been and are used for the routine analysis in the laboratory. (auth)

19846 (LA-3058) THE GRAVIMETRIC DETERMINATION OF MOLYBDENUM IN URANIUM–MOLYBDENUM ALLOYS WITH α-BENZOINOXIME. Ross D. Gardner, Carter H. Ward, and William H. Ashley (Los Alamos Scientific Lab., N. Mex.). Mar. 1964. Contract W-7405-eng-36. 10p.

The α-benzoinoxime method for the determination of molybdenum was applied and critically evaluated for the determination of molybdenum in uranium–molybdenum alloys. It was established experimentally that this method gave excellent results when applied to alloys containing 0.5 to 10% molybdenum. One hundred and twenty determinations on known solutions simulating uranium–molybdenum alloys in the above range showed an average recovery of 100.0% with a standard deviation of 0.3% relative. These knowns were analyzed over a period of several months by three different analysts. (auth)

19847 (LAMS-2378(Vol.II)) CHEMICAL DETECTORS—A BIBLIOGRAPHY FOR THE INDUSTRIAL HYGIENIST WITH ABSTRACTS AND ANNOTATIONS. Evan E. Campbell and Helen M. Miller, comps. (Los Alamos Scientific Lab., N. Mex.). Dec. 1963. Contract W-7405-eng-36. 463p.

Approximately 1000 references on chemical detectors for compounds F through Z are included, bringing the bibliography up to the end of 1963. An addenda to Vol. I for compounds A through E is included. The abstracts are arranged alphabetically by compounds. Descriptions of commercial detectors and a list of compounds found in the bibliography are appended. (P.C.H.)

19848 (ORO-591) A RADIO-RELEASE TECHNIQUE FOR THE MEASUREMENT OF MOISTURE IN GASES. Final Report. Harold G. Richter and Arthur S. Gillespie, Jr. (Research Triangle Inst., Durham, N. C.). Jan. 31, 1964. Contract AT(40-1)-2513. 13p. (RTI-2513-T12)

A radio-release procedure for the determination of minute quantities of water vapor in gases was investigated. The gas containing water vapor was passed through a column of radioactive calcium carbide ($Ca^{14}C_2$). The acetylene ($^{14}C_2H_2$) generated from the chemical reaction then passed over a Geiger-Mueller counter whereupon the count-rate was a direct measure of the water vapor content of the original gas. The ultimate sensitivity of the reaction assuming a 1% counting efficiency, a counting cell of 1 ml volume, and the highest specific activity $Ca^{14}C_2$ available being 10 mc/millimole, was calculated to be about 0.4 microns partial pressure of water vapor in the gas. This sensitivity was not achieved because the $Ca^{14}C_2$ contained gross amounts of unreacted calcium and barium metal impurities, together with an unknown amount of CaO and $Ca(OH)_2$. All of these perturb the reaction, especially since the material is inhomogeneous. A further limitation is the formation of $Ca(OH)_2$ and/or CaO on the surface of the $Ca^{14}C_2$ particles which impedes reaction as the coating builds up. Whereas the latter limitation (build-up of $Ca(OH)_2$ surface coating) can probably be overcome, the problem of preparation of pure $Ca^{14}C_2$ is a serious one. Therefore, the research was stopped. (auth)

19849 (PG-Report-583) ANALYTICAL METHOD FOR THE DETERMINATION OF CALCIUM/STRONTIUM RATIOS IN POWDER SAMPLES (X-RAY FLUORESCENCE). (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1964. 7p.

The sample is ground and sieved to a standard particle size distribution and mixed with an internal standard of the same particle size distribution. This mixture is then irradiated with white radiation from a tungsten target x-ray tube in a Philips Universal Vacuum Spectrograph. The intensities of the characteristic K α lines of calcium, strontium, and the respective internal standards titanium and yttrium are measured using a flow proportional counter. The calcium and strontium contents are determined by interpolation of the calcium/titanium and strontium/yttrium ratios determined on the sample on standard curves of calcium and strontium content versus the above ratios. The coefficient of variation at the 20% calcium level

is ±0.33% and at the 0.5% strontium level ±1.9%. The concentration range is calcium 0.5% to 40% and strontium 0.01% to 1.0%. The method is normally used for the determination of calcium and strontium in biological materials but is of general application to any material in powder form capable of being ground to the required particle size distribution and containing calcium and strontium in the above concentration range. (auth)

19850 (TID-20472) THE DETERMINATION OF PHOSPHORUS BY FAST NEUTRON ACTIVATION ANALYSIS. Maen To-on (Texas. Agricultural and Mechanical Coll., College Station. Engineering Experiment Station. Activation Analysis Research Lab.). [1963]. Contract AT (40-1)-2061. 126p.

The determination of phosphorus by fast neutron activation analysis was found to be feasible. The technique utilizes the reaction $^{31}P(n,\alpha)^{28}Al$. The half life of ^{28}Al is 2.3 minutes, and the 1.78 Mev gamma was detected by scintillation spectrometry. Possible interferences are the $^{28}Si(n,p)^{28}Al$ and $^{27}Al(n,\gamma)^{28}Al$ reactions. Interferences of both reactions were studied. The latter reaction can be eliminated by use of cadmium shielding. The former, when the weight ratio Si/P is greater than 0.65%, can only be eliminated by pre-irradiation removal of the silicon. The technique was tested on the following samples: ammonium dihydrogen phosphate, soluble phosphate, lubrication oils, biological materials, mixtures of ammonium dihydrogen phosphate-silicon dioxide, fertilizer, and phosphate rock samples. (auth)

19851 (TID-20548) COULOMETRIC ANALYSIS OF RARE-EARTH ELEMENTS AT CONTROLLED POTENTIAL. Final Report. Progress Report, February 20, 1963–February 29, 1964. Edward N. Wise (Arizona. Univ., Tucson). Mar. 20, 1964. Contract AT(11-1)-553. 8p.

The polarographic study and coulometric analysis of reducible rare earth elements using acetonitrile as the solvent and tetraethylammonium perchlorate as the electrolyte was continued. Polarography of europium perchlorate produced half-wave potentials less cathodic than literature values. The literature values could be duplicated by adding a very small amount of water to the system. Polarography of a mixture of rare-earth nitrates yielded one well-defined wave, probably due to the reduction of nitrate ion, that masked the reduction of other rare-earth elements. Coulometric reduction of europium from the mixture of rare-earth nitrates proceeded smoothly with excellent results. Polarography of a mixture of rare-earth perchlorates gave well-defined, well-separated waves for Eu(III)-(II), Yb(III)-(II), and Sm(III)-(II) reductions. Coulometric reduction of a mixture of rare-earth perchlorates gave encouraging but not complely satisfactory results. The electrochemical mechanism of the Eu(III)-(II) reduction at a mercury electrode was extensively studied. A theoretical description of the electrochemical mechanism of the reduction of rare-earth elements in aqueous, methanol, and acetonitrile solvents was developed which will aid in the prompt evaluation of other solvent-electrolyte systems. The optimum conditions for determining trace amounts of europium and uranium by the chemical stripping of zinc and cadmium, respectively, from a hanging mercury drop electrode were determined. (N.W.R.)

19852 (UJV-992/63) SUBSTOICHIOMETRIC DETERMINATION OF TRACES OF METALS BY ACTIVATION ANALYSIS OR BY ISOTOPE DILUTION. J. Růžička and J. Starý (Československá Akademie Věd. Ustav Jaderného Výzkumu, Řež). [1963]. 33p.

The substoichiometric method evolved is of importance especially in trace analysis. It greatly simplifies and speeds up the procedures hitherto used in activation analysis, and increases considerably the sensitivity of isotope dilution. Its high selectivity is caused by the fact that, unlike the other analytical methods, it uses substoichiometric amounts of reagent for determining a certain element. The high selectivity of substoichiometric separation can be utilized to advantage in the analysis of fission products. (auth)

19853 (CEA-tr-R-1711) CHAPITRE I—DOSAGE DU LITHIUM, DU RUBIDIUM ET DU CESIUM. (Chapter I—Determination of Lithium, Rubidium and Cesium). T. F. Borovik-Romanova (T. Borovik) (T. Romeneva). Translated into French from Spektral'n. Opred. Redkikh i Rasseyan. Elementov, Akad. Nauk SSSR, Inst. Geokhim. i Analit. Khim., 34-75(1962). 65p.

The determination of Li, Cs, and Rb in rocks and minerals by spectroscopic analysis is discussed. The spectra of the three elements are described, with emphasis on particularly useful lines and standards for comparisons. Methods for the analysis of samples in powder or solution form are then reviewed. The sensitivities and areas of applicability of the methods are indicated. 79 references. (D.C.W.)

19854 (SC-T-64-49) THIN-LAYER IONOPHORESIS AND THIN-LAYER IONOPHORESIS-CHROMATOGRAPHY. C. G. Honegger. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Helv. Chim. Acta, 44: 173-9(1961). 10p.

A method for the separation of substances by thin layer ionophoresis and by the two dimensional combination of thin layer ionophoresis and chromatography on glass plates is described. Kieselgel (silica-gel) G, Kieselguhr G, and Aluminumoxide G were successfully used as adsorbents for the ionophoretic separation of amines and amino acids, and Kieselgel (silica-gel) G for their combined ionophoretic-chromatographic separation. The described methods were found to be equal, in some respects even superior, to the separation of amines and amino acids on paper. (auth)

19855 (UCRL-Trans-1011(L)) NEW SPECIAL REAGENT AND A NEW METHOD FOR DETERMINING ANTIMONY. Fritz Feigl. Translated by Sergey Shewchuck (Univ. of California. Lawrence Radiation Lab., Livermore), from Z. Anal. Chem., 64: 41-7(1924). 10p.

Pyrocatechol and pyrogallol forms insoluble compounds with $SbCl_3$ in mineral acid solution. The composition of the Sb–pyrogallol compound corresponds to $SbC_6H_5O_4$, and its probable structure and relationship to the Cu–benzoin oxime compound are discussed. Experiments were made on the qualitative and quantitative determination of Sb; the results obtained indicate that Sb can be determined gravimetrically as the pyrogallate. Sb could also be separated from As by pyrogallol. (D.L.C.)

19856 SIMPLIFIED PROCEDURES FOR RADIOASSAY AND AUTORADIOGRAPHY OF PLANT MATERIALS. Edgar Inselberg (Na-Churs Plant Food Co., Marion, Ohio). Argon. J., 51: 301-6(1959).

Compared with the conventional end window Geiger tube, the jacketed counter for the radioassay of liquids had higher precision and counting efficiency, eliminated the need for pipetting and evaporating samples prior to radioassay, and was suitable for counting digested plant samples. The autoradiographic technique was considerably simplified through the use of individually packed film, thus eliminating the need for light-proof equipment. Autoradio-

grams of corn, soybeans, tobacco, and tomato plants are presented. (auth)

19857 ION EXCHANGE CHROMATOGRAPHY. Harold F. Walton (Univ. of Colorado, Boulder). Anal. Chem., 36: 51R-5R(Apr. 1964).

Applications of ion-exchanging materials to chemical separations in columns are reviewed. The exploitation of existing methods, such as the use of anion exchange in complexing media to separate metals, is discussed. Some inorganic exchangers have been studied systematically, and new ones have been prepared; mixed solvents have been put to good use in metal separations; techniques have been developed for monitoring column effluents automatically, especially techniques in which reagents are fed continuously into effluent streams for color development. Advances have also been made in the theory of column performance and of isotope separation. 152 references are included for the period through Dec. 1963. (P.C.H.)

19858 FLUOROMETRIC ANALYSIS. Charles E. White (Univ. of Maryland, College Park) and Alfred Weissler. Anal. Chem., 36: 116R-29R(Apr. 1964).

A review is presented on fluorometric analysis. Apparatus, and inorganic and organic and biological fluorometric analysis are discussed. 557 references are included for the 2-year period from approximately December 1961 to December 1963. (P.C.H.)

19859 ION EXCHANGE. Robert Kunin and F. X. McGarvey (Rohm and Haas Co., Philadelphia). Anal. Chem., 36: 142R-4R(Apr. 1964).

A review on ion exchange is presented, including discussion on theory, equilibrium and selectivity, concentration of dilute solutions, inorganic analysis, organic and biochemical analysis, and ion exchange papers. 75 references are included for the period Nov. 1961 to Nov. 1963. (P.C.H.)

19860 LIGHT ABSORPTION SPECTROMETRY. D. F. Boltz (Wayne State Univ., Detroit) and M. G. Mellon. Anal. Chem., 36: 256R-66R(Apr. 1964).

A review is presented on developments in light absorption spectrometry. Methods and applications in chemistry and physics are discussed. 495 references are included for the period Oct. 1961 through Oct. 1963. (P.C.H.)

19861 MASS SPECTROMETRY. Robert M. Reese and Fredric N. Harllee (National Bureau of Standards, Washington, D. C.). Anal. Chem., 36: 278R-95R(Apr. 1964).

Developments in mass spectrometry are reviewed. Design and instrumentation; analytical applications; precise mass measurement and isotope abundance; nuclear and geochemistry; quasi-equilibrium theory; mass spectra; ion-molecule reactions, charge exchange, and cross section measurements; ionization and dissociation processes; thermodynamics; chemistry; sputtering and surfaces; photoionization; and isotopes are discussed. 614 references are included for the period Nov. 1961 through Oct. 1963. (P.C.H.)

19862 X-RAY ABSORPTION AND EMISSION. William J. Campbell and James D. Brown (Bureau of Mines, College Park, Md.). Anal. Chem., 36: 312R-28R(Apr. 1964).

A critical review of fundamental developments and tabular summaries of applications of x-ray spectrography and electron probe microanalysis is presented. Absorption, x-ray scattering, chemical effects on x-ray spectra, instrumentation, emission, coatings, and electron probe microanalysis, are discussed. Data on specific x-ray spectrographic analysis are tabulated. 519 references are included for the period from Dec. 1961 to Nov. 1963. (P.C.H.)

19863 EMISSION SPECTROMETRY. Bourdon F. Scribner and Marvin Margoshes (National Bureau of Standards, Washington, D. C.). Anal. Chem., 36: 329R-43R (Apr. 1964).

Developments in emission spectrometry are reviewed. Spectral descriptions and classifications, spectroscopic instrumentation, excitation, standards and calibration, isotopic analysis, trace analysis, determination of nonmetallic elements, analysis of metals, analysis of nonmetals, flame photometry, and atomic absorption spectrometry, are discussed. 565 references are included for the period 1962 through Dec. 1963 with some material that appeared in 1961. (P.C.H.)

19864 THERMAL ANALYSIS. C. B. Murphy (General Electric Co., Schenectady, N. Y.). Anal. Chem., 36: 347R-54R(Apr. 1964).

Significant trends and applications of techniques in differential thermal analysis are reviewed. Thermogravimetry, dilatometry, electrical measurements, and differential thermal analysis, are discussed. 254 references are included for the period Oct. 1961 to ca Oct. 1963. (P.C.H.)

19865 VOLUMETRIC AND GRAVIMETRIC ANALYTICAL METHODS FOR INORGANIC COMPOUNDS. W. H. McCurdy, Jr. (Univ. of Delaware, Newark) and D. H. Wilkins. Anal. Chem., 36: 381R-90R(Apr. 1964).

New quantitative inorganic chemical reactions, valuable interference studies or improvements in established analytical procedures, and important contributions to the theory of precipitation and titrimetric processes are reviewed. Significant trends, gravimetric analysis, and gravimetric determination are discussed. 240 references are included for the period Jan. 1962 to Dec. 1963. (P.C.H.)

19866 X-RAY DIFFRACTION. Lynne L. Merritt, Jr. and William E. Streib (Indiana Univ., Bloomington). Anal. Chem., 36: 399R-404R(Apr. 1964).

Developments in techniques and apparatus for x-ray diffraction analysis are reviewed. General applications of x-ray diffraction and current interests in the field of structural determinations are discussed. 209 references are included for the period 1962 through 1963. (P.C.H.)

19867 NUCLEONICS. G. W. Leddicotte (Union Carbide Co., Tuxedo, N. Y.). Anal. Chem., 36: 419R-53R(Apr. 1964).

A general review is presented on the fundamental developments in nuclear methods of analysis. Activation analysis, isotope dilution and radiometric methods, separation procedures, and the use of radioisotopes as sources and as tracers in developing analytical methods are discussed. Special attention is given to applications of radioisotopes as tracers. Data on radiochemical separations, activation analysis applications, and radioactive tracers in analytical chemistry are tabulated. 1767 references are included for the period late 1961 to late 1963. (P.C.H.)

19868 KINETIC ASPECTS OF ANALYTICAL CHEMISTRY. Garry A. Rechnitz (Univ. of Pennsylvania, Philadelphia). Anal. Chem., 36: 453R-7R(Apr. 1964).

Developments in the kinetic aspects of analytical chemistry are discussed. The generalization of kinetic models suitable for the classification of reactions according to their mechanistic properties is discussed. Catalytic reactions and analysis by reaction rates are also considered. 94 references are included for the period 1960 through 1963. (P.C.H.)

19869 AMPEROMETRIC TITRATION OF CHROMIUM IN MIXTURES OF FLUORIDE SALTS. R. F. Apple and H. E. Zittel (Oak Ridge National Lab., Tenn.). Anal. Chem., 36: 983-5(May 1964).

A rapid and precise method for the amperometric titration of chromium in mixtures of fluoride salts was developed. The salt is dissolved in a mineral acid mixture, after which the chromium is oxidized to Cr(VI) with argentic oxide. The Cr(VI) is then amperometrically titrated with ferrous sulfate. This reduction causes no change in cell current until the end point is reached where the current decreases. The titration is followed by means of a polarograph equipped with a titration cell that consists of a pyrolytic graphite electrode vs the S.C.E. The optimum potential for the titration is +1.0 volt vs the S.C.E. In the range of 1 to 50 μg of Cr(VI) titrated, the relative standard deviation is less than 2%. Of the interferences studied, only Mn(VII) and Ce(IV) interfere with the method at the level of concentrations studied. (auth)

19870 A CONTINUOUS FLOW ANALYZER FOR RECORDING OF LIGHT ABSORPTION AND RADIOACTIVITY IN THE ELUATES FROM CHROMATOGRAPHIC COLUMNS. C. Iwar Sjoeberg and Gunnar Agren (Uppsala Univ.). Anal. Chem., 36: 1017-21(May 1964).

The description of an automatic recording device for location and quantitative measurement of ultraviolet absorption of nucleotides in the fluid emerging from ion exchange columns is given. The absorption signal is fed into a strip chart multipoint recorder, which also accepts the output signals from a dual rate meter with two separate outputs for linear and logarithmic readings of radioactivity. (auth)

19871 GRAVIMETRIC DETERMINATION OF ZIRCONIUM AND HAFNIUM BY AROMATIC CARBOXYLIC ACIDS. Anil K. Mukherji (Louisiana State Univ., New Orleans). Anal. Chem., 36: 1064-6(May 1964).

1,3,5-Benzenetricarboxylic (trimesic) acid, 1,2,4-benzenetricarboxylic (trimellitic) acid, and 1,2,4,5-benzenetetracarboxylic (pyromellitic) acid are proposed as new reagents for the gravimetric determination of zirconium and hafnium. Bismuth(III) and cerium(IV) are the only interferences and their prior removal presents no difficulty. For 10 determinations of zirconium at a 95% confidence interval, the confidence limit ranges from 0.30 to 0.33 mg for 19.7-mg samples for the three reagents; for hafnium the confidence limit ranges from 0.28 to 0.30 mg for 17.1-mg samples. Five- to 8-mg quantities of zirconium and hafnium can be determined. The precipitates contain the reagent molecule and zirconyl and hafnyl ions in a 1 to 1 ratio. Data on thermal decomposition of the precipitates are presented. (auth)

19872 STATISTICAL ASPECTS OF DOUBLE ISOTOPE LIQUID SCINTILLATION COUNTING BY INTERNAL STANDARD TECHNIQUE. R. J. Herberg (Lilly Research Labs., Indianapolis). Anal. Chem., 36: 1079-82(May 1964).

Equations were derived for calculation of the error in the disintegration rates of two isotopes in a mixture. The way in which the equations can be used to determine useful internal standard activities, channel settings, and isotope ratios is shown. For mixtures of carbon-14 and tritium, internal standard activities of 50,000–100,000 dpm for carbon-14 and 100,000–150,000 dpm for tritium are useful as single routine quantities. A 1-minute counting time after internal standard addition is routinely adequate. (auth)

19873 LIQUID SCINTILLATION COUNTING OF DOUBLY-LABELED SAMPLES. CHOICE OF COUNTING CONDITIONS FOR BEST PRECISION IN TWO-CHANNEL COUNTING. Elizabeth T. Bush (Nuclear-Chicago Corp., Des Plaines, Ill.). Anal. Chem., 36: 1082-9(May 1964).

The statistical precision with which two beta emitters may be determined in a single sample depends on the way the pulse height spectrum is positioned in the windows of the beta spectrometer. The best choice of the counter parameters, window width and gain, is discussed in relation to the isotope ratio, the absolute activity level, and the degree of quenching. Optimum counter settings are given for the isotope pairs $H^3 + C^{14}$, $H^3 + P^{32}$, and $C^{14} + P^{32}$. Settings for other isotope pairs may be inferred by comparing the separation in the energies of those isotopes with the ones studied. (auth)

19874 A COMPUTER PROGRAM TO OPTIMIZE TIMES OF IRRADIATION AND DECAY IN ACTIVATION ANALYSIS. Thomas L. Isenhour and George H. Morrison (Cornell Univ., Ithaca, N. Y.). Anal. Chem., 36: 1089-92 (May 1964).

To achieve increased selectivity in instrumental activation analysis, a computer program was developed that rapidly determines the optimum times of irradiation and decay for activation analysis of any element in any mixture regardless of its complexity. The program is generalized for any combination of nuclear reactions, involving both elements for analysis and as interferences. Mathematical solution is accomplished through an iterative approximation process. The program is described in detail and examples of its application are given. (auth)

19875 LIQUID SCINTILLATION COUNTING OF PROMETHIUM-147, BIOASSAY PROCEDURE. J. D. Ludwick (General Electric Co., Richland, Wash.). Anal. Chem., 36: 1104-6(May 1964). (HW-SA-3244)

Techniques were developed for the introduction and quantitative determination of promethium-147 in liquid scintillator. Use of dimethyl-POPOP at optimum concentrations with other scintillator components facilitated the utilization of liquid scintillator for absolute standardization of the weak beta emitter promethium-147, and contributed to a sensitive bioassay procedure for analysis of the radioisotope. A minimum chemical separation and sample process time makes this technique most desirable for routine use. Urine samples were treated to remove colored organic components and finally extracted into the scintillator with di-2-ethyl hexyl phosphoric acid. The sensitivity of the method for a 10-minute sample count was about 2×10^{-6} μc. (auth)

19876 ACTIVATION ANALYSIS OF HIGH PURITY MATERIALS. W. J. Ross (Oak Ridge National Lab., Tenn.). Anal. Chem., 36: 1114-19(May 1964).

Samples of high purity beryllium, aluminum, and iron were analyzed for trace amounts of 62 possible elemental impurities by measuring the gamma activities of radionuclides produced by neutron activation. Ten elements were determined by nondestructive techniques after bombarding a portion of the sample for 10 seconds and making a rapid measurement of the short-lived radionuclides that are induced. A second portion of the sample was activated for 20 minutes and analyzed for the gamma-emitting radionuclides of chlorine, bromine, and iodine. Forty-nine elements can be determined in a third portion of the sample after a 16-hour irradiation. The induced radionuclides are divided into six groups by a series of rapid chemical separations and each gamma activity is identified, counted, and compared with that of a standard radionuclide. (auth)

19877 LARGE VOLUME ACTIVATION ANALYSIS OF ORGANICALLY BOUND IODINE USING ISOTOPIC NEUTRON SOURCES. Ralph Grunewald, P. L. Ziemer, and J. E. Christian (Purdue Univ., Lafayette, Ind.). Anal. Chem., 36: 1138-40(May 1964).

A method for the determination of organically bound iodine by the technique of neutron activation analysis was developed with specific reference to acetrizoic acid. Complete analysis can be carried out in less than 1 hr. The estimated precision would be ±6.8 and ±3.97% for 10 and 50% sodium acetrizoate solutions, respectively using the conditions described. (P.C.H.)

19878 OPTIMUM COUNTING TIMES FOR TWO SOURCES AND BACKGROUND IN MASS SPECTROMETRY. J. L. Jaech (General Electric Co., Pleasanton, Calif.). Anal. Chem., 36: 1164-5(May 1964).

Counting statistics theory for finding the variance of the isotopic ratio of the more abundant to the less abundant isotope is presented. Since it is desirable to make the variance as small as possible, values of T_1, T_2, and T_3 were selected so as to minimize the variance, subject to the constraint that the total counting time is fixed. Illustrations of the formulations are given. (P.C.H.)

19879 PREPARATION, HIGH TEMPERATURE PROPERTIES, AND ANALYTICAL USES OF TUNGSTEN TRIOXIDE. Mark A. Carey, Bruce A. Raby, and Charles V. Banks (Iowa State Univ., Ames). Anal. Chem., 36: 1166-7 (May 1964). (IS-773)

Studies indicate that tungsten trioxide can be prepared at a temperature of 500 to 700°C. Below 500°C, dehydration may be incomplete. Above 700°C, volatilization becomes an important consideration. At no temperature below 1000°C is a change of stoichiometry important, if an adequate amount of oxygen is present. (P.C.H.)

19880 AN ION EXCHANGE METHOD FOR THE DETERMINATION OF CESIUM-137 AND STRONTIUM-90 IN FALLOUT. Hiroyuki Tsubota (National Inst. of Radiological Sciences, Kurosuna-cho, Chiba-shi, Japan). Bull. Chem. Soc. Japan, 36: 1545-8(Dec. 1963).

A rapid method was developed for the determination of ^{137}Cs and ^{90}Sr in fallout by ion exchange. The procedure is described. The analysis was carried out by using an artificial fallout solution containing labeled cesium and strontium. The recovery was 98 ± 4% for Sr and 99 ± 3% for Cs. Agreement with results of other methods was satisfactory. (P.C.H.)

19881 DETERMINATION OF RHENIUM IN RHENIUM–TUNGSTEN ALLOY. Masayoshi Huseya (Hitachi Ltd., Mobara City, Chiba, Japan). Bunseki Kagaku, 13: 122-6 (Feb. 1964). (In Japanese)

Adequate conditions for the stable color-development in the reaction of rhenium with dimethylglyoxime and stannous chloride in the rapid determination of rhenium in rhenium–tungsten alloys by dimethylglyoxime method are described. The analytical procedure is as follows: 7.5 ml of 30% citric acid solution is added to alkali-fused solution of sample (10 ml) in a 250 ml volumetric flask, followed by additions of 2.5 ml of 12N hydrochloric acid solution, 6 ml of 1% dimethylglyoxime solution, 5 ml of 25% stannous chloride solution, and it is finally made up to 250 ml with 3N hydrochloric acid. After 5 minutes, the absorbance was measured at 462 mμ. Tungsten does not interfere in the existence of citric acid, while nickel, iron, and molybdenum interfere in concentration more than 2 mg/250 ml. Interference by iron, however, is removed by reducing Fe^{3+} to Fe^{2+} with stannous chloride. The error in the proposed method is less than ±1.0% and the method was applied for the routine analysis of rhenium–tungsten alloys. (auth)

19882 DETERMINATION OF ZIRCONIUM, BORON, CARBON, AND SILICON IN ZIRCONIUM DIBORIDE. Yasuo Takahashi (Inst. of Physical and Chemical Research, Tokyo). Bunseki Kagaku, 13: 193-9(Mar. 1964). (In Japanese)

Chemical properties of zirconium diboride prepared by carbothermic reduction of mixture of ZrO_2 and B_2O_3 were studied, and methods for the determination of Zr, B, C, and Si were investigated. It was found that sodium carbonate fusion was the most practical means for disolution of zirconium diboride for the determination of Zr and B in a single sample. The melt was digested with water, and Zr was separated by filtering. Boron in the filtrate, after neutralization, removal of CO_2, and the addition of mannite, was titrated with 0.1N NaOH solution from pH 7.0 to the end point of pH 8.3. The residue, of which the major part was ZrO_2, was fused with $K_2S_2O_7$, and the melt obtained was dissolved in dilute H_2SO_4. Zirconium in the solution was precipitated by cupferron, ignited to ZrO_2, and weighed. Carbon was volumetrically determined by the combustion method, using Pb_3O_4 or CuO as an accelerator. Silicon was determined colorimetrically as silicomolybdate by dissolving the sample in a mixture of 3N HF and 2N HNO_3 at 70~ 80°C. Fluoride was masked by H_3BO_3, ammonium molybdate was added, and pH was adjusted between 1.2 and 1.3. Molybdenum blue method was used for low concentrations of silicon. The method was also successfully applied for the analysis of hafnium diboride. (auth)

19883 SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTH ELEMENTS IN THORIUM BY XYLENOL ORANGE. Hiroyuki Yoshida (Japan Atomic Energy Research Inst., Tokyo). Bunseki Kagaku, 13: 203-6(Mar. 1964). (In Japanese)

A spectrophotometric method for determining 20 ~ 200 ppm of rare earth elements in thorium is described. The removal of thorium is effected by thiocyanate-tributyl phosphate (TBP) extraction. The concentration of ammonium thiocyanate in the sample solution is adjusted to 2M, and thorium is extracted into 15% TBP–CCl_4. In order to extract thorium completely, two successive extractions are carried out by 5% TBP–CCl_4. Then, rare earth elements in the aqueous phase are extracted into 50% TBP-n-hexane and again back-extracted into 0.5M acetate buffer solution (pH = 6.0). The pH of the aqueous phase is adjusted to 6.0 ± 0.1, and rare earth elements are determined spectrophotometrically with xylenol orange. (auth)

19884 DETERMINATION OF ZIRCONIUM WITH FLAVONOL-2′-SULFONIC ACID. Yoshinaga Oka and Mieko Yanai (Tohoku Univ., Sendai). Bunseki Kagaku, 13: 207-12(Mar. 1964). (In Japanese)

Zirconium reacts with flavonol-2′-sulfonic acid in an acidic solution to form 1:1 and 1:2 chelates, which show the absorption maxima at 358 and 364 mμ, respectively. Their stability constants were estimated spectrophotometrically to be 4.5×10^{13} and 5.6×10^{10}, respectively, at 25°C and with ionic strength of 2.00. The acid dissociation constant of the ligand was 5.0×10^{-9} under the same conditions. As little as 0.1 μg/ml of zirconium was determined satisfactorily by the use of the 1:2 chelate. The system conforms well to Beer's law. (auth)

19885 APPLICATION OF THE SOLVENT EXTRACTION SEPARATION METHOD WITH ACETYL ACETONE TO THORIUM ANALYSIS. Ken-ichi Tsutsumi (Mitsui Mining and Smelting Co., Ltd., Tokyo). Bunseki Kagaku, 13: 235-9(Mar. 1964). (In Japanese)

The applications of the previously reported solvent extraction separation method in the system of acetyl acetone complexes-carbon tetrachloride to thorium-related samples were investigated. Sulfuric acid for Korean monazites,

sodium peroxide fusion for Malayan xenotimes, and hydrochloric acid for thorium phosphates are conveniently preferred for the sample opening, respectively. Hydrofluoric acid as a group separating agent of thorium and rare earths has a great advantage over oxalic acid because of its little solubility losses and the direct dissolution of some insoluble hydrolysis precipitates. The hardness of filtering of the gelatinous fluoride precipitates, which is one of the difficulties in the procedure, can be avoided by evaporating the precipitates to dryness on a steam bath. Oxalic acid as a precipitant should be used separately for thorium and rare earths. The combined method of some modified group separation with hydrofluoric acid and the proposed solvent extraction separation is recognized to be effective, by which thorium, cerium, and the total rare earths were determined in Korean monazite with coefficients of variation of, respectively, 1.7, 0.2, and 0.3%. In addition, the potentiometry with potassium ferrocyanide for cerium analysis is also found to be suitable. (auth)

19886 DETERMINATION OF OXYGEN IN METALS BY 14-Mev NEUTRON ACTIVATION. Isao Fujii, Haruo Muto, and Katsuhiko Miyoshi (Tokyo Shibaura Electric Co., Ltd.). Bunseki Kagaku, 13: 249-54(Mar. 1964). (In Japanese)

A method is described for the determination of oxygen in metals by 14 Mev neutron activation. The analytical instrument consists of a 14 Mev neutron generator (10^{10} neutron/sec), an automatic controller with a sample transfer system, a C-R neutron monitoring system (automatically normalizing) with automatic corrections for the influence of the fluctuation of neutron flux at a bombardment of samples, and a measuring apparatus. Analytical results for oxygen in iron, titanium, Zircaloy, copper, stainless steel, and nickel by the proposed neutron activation method are in good agreement with those by the vacuum fusion technique. The limit of detection by the method is about 200 μg, and the precision is about $\pm 5 \sim 10\%$ in level of 1 mg oxygen content. The method is rapid and nondestructive, and some thirty prepared samples can be analyzed in an hour. It is useful for industrial purposes such as the quality control of metallic products. (auth)

19887 TRITIUM DETERMINATIONS BY MEANS OF A LIQUID SCINTILLATION COUNTER. Arpad Veres. Fiz. Szemle, 13: 375-9(Dec. 1963). (In Hungarian)

The widespread application of T in medical, biological, and geological research is slowed down by difficulties involved in the detection and determination of this isotope. The maximum energy of the β particles of T is 18.5 kev, with an average energy of 5.6 kev, while the free path of the particles in air is of the order of 2 cm; this makes it impossible to use an end-window G-M tube for the measurements. Tests were therefore carried out for the development of a detection system based on a liquid scintillator. A liquid scintillator containing naphthalene and purified dioxane was used in connection with a specially constructed photomultiplier tube. The results were better than those obtained previously. Further improvements may be expected by increasing the volume of the container and using cooling. The device was found useful for measuring the maximum permissible concentration of T, amounting to 3×10^{-2} μcurie ml. (TTT)

19888 STRONTIUM CONTAMINATION IN MINERAL ANALYSES. G. J. Wasserburg, T. Wen, and J. Aronson (California Inst. of Tech., Pasadena). Geochim Cosmochim. Acta, 28: 407-10(Apr. 1964).

Significant amounts of strontium contamination occur in analyses of minerals by standard procedures using laboratory glassware. The contamination is much higher than that obtained in blank runs and is associated with the presence of some mineral samples. The contamination can be eliminated by using only teflon and platinum ware during chemical treatment. (auth)

19889 IMPROVED CELL FOR DETERMINING EXTRACTABLES IN IRRADIATED MATERIALS. Vincent F. Maturi (National Aeronautics and Space Administration, Washington, D. C.) and Edward Garlock. J. Assoc. Offic. Agr. Chemists, 47: 382-5(Apr. 1964).

The contact of the packaging materials with food results in the transfer of trace amounts of extractables from the package to the food. Two types of extraction cells are described for use in determining extractables in irradiated materials. Data are presented on extractables from commercial plastic film, cellulose acetate, polyethylene, polystyrene, and paraffin-coated paperboard before and after receiving a radiation dose of 1.0 Mrad from a ^{60}Co γ source. (C.H.)

19890 MEASUREMENT OF TRITIUM BY MEANS OF A LIQUID SCINTILLATOR. F. Kőhegyi, C. P. Fodorné, and B. Lévay. Magy. Kem. Folyoirat, 68: 429-32(Oct. 1962). (In Hungarian)

A coincidence circuit was used to measure the radiation of tritium with a scintillator; the photoelectron multipliers were maintained at 15°C by a thermostat. The sample exchanger used permitted thermostatic control of the samples, their exchange in the dark and reduced the heat sensibility of the photocathode by employing light conductors. (OID)

19891 MEASUREMENT OF TRITIUM BY MEANS OF A LIQUID SCINTILLATOR IN COINCIDENCE CIRCUIT. PART II. C. P. Fodorné, B. Levay, and F. Kohegyi. Magy. Kem. Folyoirat, 68: 482-5(Nov. 1962). (In Hungarian)

The phosphorescence of the glass cell containing the liquid scintillator and that of suitable solvents was measured. Results showed that though phosphorescence due to the glass cell and solvents may be considerable, even taken together they do not cause higher count rates than 20 to 30 impulses/min. This means that together with the noise produced by the electron multipliers, the value obtained is not higher than 100 impulses/min. The value of the zero effect for the reflecting cell filled with the scintillator is about 1200 impulses/min when no Pb shielding is used. After 15 to 30 min, values measured in coincidence are constant, thus measurement may be started. ^{137}Ba isotope can be measured in coincidence with an efficiency averaging 80% in a cell having no reflector, and 85% with a reflector if the ^{137}Ba is used as an external source of radiation. (OID)

19892 THE APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE TRACE ELEMENT STUDY IN NUCLEIC ACIDS. G. Stehlik and H. Altmann (Institut für Biologie und Landwirtschaft des Reaktorzentrums, Seibersdorf, Austria). Monatsh. Chem., 94: 1163-7(1963). (In German)

A method is described for determining trace elements in nucleic acids quantitatively by neutron activation and wet ashing of the organic materials for chemical separation. After addition of carrier the individual elements are separated from one another by specific complex formation at different pH values with the help of liquid extraction. By comparison of the gamma spectra obtained with that from standards, which was obtained under the same conditions, these trace elements could be determined quantitatively. For determination of the specific content of these metal ions in nucleic acid it was especially advantageous

to simultaneously measure in the same course of work the activated phosphorus. The trace element contents of various nucleic acids measured by this method are given. (tr-auth)

19893 NEW METHOD FOR DIRECT MEASUREMENT OF THE ATMOSPHERIC THORON CONTENT. Gerhard W. Israel (Technische Hochschule, Aachen). Naturwissenschaften, 51: 134-5(1964). (In German)

A method for determining the thoron (^{220}Rn) content in air is described. The air was directed over a filter which freed it from ions, fission products of radon and thoron, and aerosols into an ionization chamber. During the aspiration an ionization current was measured, which was composed of the radon and thoron parts of the null effect. After shutting off the air current the ionization current in a few minutes decreased to the thoron part. The measurements showed that the apparatus arrangement could be used for measuring thoron concentrations in the air from 10^{-13} C/l with an exactness of 15%. (M.C.G.)

19894 QUANTITATIVE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN TANTALUM AND ITS COMPOUNDS BY D.C. ARC METHOD. Nakaaki Oda and Mitsuru Idohara (Nippon Soda Co., Takaoka, Japan). Nippon Kinzoku Gakkaishi, 28: 39-43(Jan. 1964). (In Japanese)

Recent developments of the tantalum refining industry made it necessary to determine the trace impurities in the high purity tantalum products. To meet the requirement of increasing sensitivity, a spectrographic d-c arc method was studied with a medium quartz spectrograph Qu-24. Experiments were carried out to establish the optimum conditions in regard to the various factors, such as carrier, arc current, exposure time, internal standard, analytical line pairs, etc., yielding a sensitive, simple, and rapid method, suited for practical uses. The method includes converting sample to oxide, mixing with carbon powder, which contains two internal standard materials (GeO_2, BeO), arcing in a d-c arc, and photographing spectra with a medium quartz spectrograph. The method can be applied to the analysis of the high purity tantalum products of various forms that could be brought into tantalum oxide, and used to determine the fourteen elements in them at the concentrations greater than: 0.01% of Nb, W; 0.003% of Mo; 0.001% of Ti; 0.0005% of Fe, Ca; 0.0003% of Si, Cr, V, Ni, Al; 0.0001% of Mn, Cu; and 0.00003% of Mg, with the precision of about 10%, in terms of the variation coefficient. (auth)

19895 THE SPECTROPHOTOMETRIC DETERMINATION OF RARE EARTH ELEMENTS BY MEANS OF 4-(2-PYRIDYLAZO)-RESORCINOL. Shun-jung Wang, Shih-fun Mou, and Shu-chuan Liang (Univ. of Science and Tech., Peking). Sci. Sinica (Peking), 13: 522-3(Mar. 1964).

The results of an investigation on the use of 4-(2-pyridylazo)-resorcinol (PAR) as a colorimetric reagent in the spectrophotometric determination of rare earth elements are reported. The optical densities of the rare earth-PAR complexes change with acidity of the medium. PAR is most sensitive toward yttrium and least sensitive toward lanthanum among the rare earths studied. (C.E.S.)

19896 THE DETERMINATION OF THE OXIDATION STATES OF TRACER URANIUM, NEPTUNIUM AND PLUTONIUM IN AQUEOUS MEDIA. S. C. Foti and E. C. Freiling (Naval Radiological Defense Lab., San Francisco). Talanta, 11: 385-92(Mar. 1964).

The development, testing, and application of a chemical procedure for determining the distributions of uranium, neptunium, and plutonium among their respective oxidation states in various aqueous media at tracer concentrations are described. The separations achieved are of the order of 95% clean. Results are presented that show the per cent extraction of uranium, neptunium, and plutonium oxidation states by 0.4M 2-thenoyltrifluoracetone at various values of pH, and per cent carried by lanthanum fluoride from distilled water and sea water under various conditions. Radiochemical analysis of the separated fractions can then be used to determine the required oxidation state distributions. (auth)

19897 THERMOGRAVIMETRIC AND DIFFERENTIAL THERMAL ANALYSIS OF EUROPIUM^{III} OXALATE AND SOME EUROPIUM^{II} SALTS. A. Glasner, E. Levy, M. Steinberg, and W. Bodenheimer (Hebrew Univ., Jerusalem). Talanta, 11: 405-14(Mar. 1964).

The thermal analysis curves of $Eu_2(C_2O_4)_3$, EuC_2O_4, and $EuCO_3$ exhibit prominent exothermic peaks in the region of 420° because of the oxidation of europium$^{(II)}$ to europium$^{(III)}$. The first step in the decomposition of $Eu_2(C_2O_4)_3$, after completion of dehydration, is $Eu_2(C_2O_4)_3 \rightarrow 2EuC_2O_4 + 2CO_2$. The reasons for some conflicting differential thermal analysis curves of the rare earth oxalates obtained by others are explained. The europium$^{(II)}$ oxalate, $EuC_2O_4 \cdot 1.7H_2O$, was prepared. (auth)

19898 SELECTIVE DETERMINATION OF TRACE AMOUNTS OF COBALT USING THE SORPTION OF $Co(Phen)_3^{2+}$ ON SILICA. Frantisek Vydra (Polarographic Inst., Prague). Talanta, 11: 433-9(Mar. 1964).

The fact that the sorption of $Co(Phen)_3^{2+}$ on silica is not affected by EDTA or citric acid in appropriate conditions of acidity was used for the selective determination of microgram amounts of cobalt. Desorption of $Co(Phen)_3^{2+}$ is carried out from an alkaline aqueous-methanolic solution of ammonium formate, and cobalt is determined indirectly, colorimetrically, via ferroin. Special attention was paid to the determination of trace amounts of cobalt in the presence of iron. (auth)

19899 CHELATING RADIOMETRIC TITRATIONS BY ION EXCHANGE FOR DETERMINATION OF TRACES OF METALS. Jiri Starý, Jaromir Růzicka, and Adolf Zeman (Faculty of Technical and Nuclear Physics, Prague). Talanta, 11: 481-4(Mar. 1964).

A new type of radiometric titration was developed. Using EDTA solutions, negatively charged or neutral metal chelates are formed, and these can easily be separated from the excess of unreacted metal ions using a cation exchanger. Titration curves are constructed from the activities of the eluates. The method was used for the determination of microgram amounts of indium using ^{114m}In as an isotopic tracer, and for the determination of submicrogram traces of cobalt using the same indicator as a non-isotopic tracer. (auth)

19900 INDIRECT DETERMINATION OF TRACES OF URANIUM USING 1-(2-PYRIDYLAZO-)2-NAPHTHOL. M. R. Hayes and J. S. Wright (United Kingdom Atomic Energy Authority, Lancashire, Eng.). Talanta, 11: 607-16(Mar. 1964).

In the determination of traces of uranium using 1-(2-pyridylazo)-2-naphthol (PAN), solvent extraction of the complex is replaced by the separation of the insoluble complex from homogeneous solution. This is followed by hydrolysis to give free PAN equivalent to the uranium present. An increase in sensitivity of almost 50% results and the conditions for complex formation require less stringent control. A general method for the determination of uranium in impure liquors is described. Reversed-phase partition chromatography is used for the initial

separation of uranium, followed by the use of complexing agents to prevent interference from any residual ions. The method is simple and rapid, and the precision compares favorably with other methods using PAN. (auth)

19901 AMPEROMETRIC DETERMINATION OF LANTHANUM AS MOLYBDATE. R. S. Saxena and M. L. Mittal (Government Coll., Rajaputana, India). Talanta, 11: 649-52(Mar. 1964).

The reaction between lanthanum and molybdate ions was followed by means of direct and reverse amperometric titration in aqueous and aqueous-alcoholic media at an applied potential of −1.5 v (vs S.C.E.). The amperometric end-point obtained from the sharp break in the titration curves occurs when the molecular ratio of $La^{3+}:MoO_4^{2-}$ is 2:3 and corresponds to the formation and precipitation of normal lanthanum molybdate, $La_2O_3 \cdot 3MoO_3$, at pH 5–6. Amperometric titrations yield very accurate and reproducible results and offer a simple and rapid method for the determination of lanthanum as molybdate even at low concentrations (1×10^{-3} M lanthanum nitrate). (auth)

19902 A SIMPLE METHOD FOR THE DETERMINATION OF CARBON IN URANIUM AND PLUTONIUM CARBIDES. H. D. Sharma and M. S. Subramanian (Atomic Energy Establishment, Trombay, India). Talanta, 11: 655-9(Mar. 1964).

A simple method for the determination of combined and free carbon in the carbides of uranium and plutonium is based on the examination of the oxidation of carbide and free carbon thermogravimetrically. The combined carbon (carbide) oxidises to carbon dioxide in air below 500°C while the free carbon oxidises above 600°C. This allows the determination of both combined and free carbon in a single sample, using a furnace tube and a conventional method for carbon dioxide. (auth)

19903 THE USE OF IRRADIATION FOR QUANTITATIVE TESTS OF IRON SURFACE ENRICHMENT BY ARSENIC. F. Vodopivec (Metallurgical Inst., Ljubljana, Yugoslavia). Tehnika (Belgrade), 18: No. 1, 25-31(Jan. 1963). (In Serbo-Croatian)

Arsenic accumulates as a result of the selective oxidation of Fe during oxidation in the metal near the metal-oxide interface. The separation of the As in the enriched layer of the metal was determined by using ^{76}As. With this technique, 0.075% As samples of iron alloy were oxidized in a mixture of water and hydrogen vapor and then irradiated for 3 to 6 days in a nuclear reactor. The precipitate of the radioactive As formed from the S using molybdenum sulfide as the catalyst. Results showed a separate curve for the As in the enriched metal layer similar to the diffusion curve in a solid solution after oxidation at 800°C. For oxidation at 1,000°C, the As separation curve was similar to a diffusion curve in a limited solubility system. (OID)

19904 THE DETERMINATION OF THE HYDROCARBON CONTENT BY RADIOISOTOPE AND NEUTRON RADIATIONS. III. THE DETERMINATION OF THE HYDROGEN CONTENT BY γ-RAY ABSORPTION AND FAST NEUTRON MODERATION. P. Parezanović. Tehnika (Belgrade), 18: No. 1, 32-6(Jan. 1963). (In Serbo-Croatian)

A method for determining the C/H ratio of hydrocarbons from the absorption of γ rays is described. After a brief description of the theoretical principles for measuring the hydrogen content in the organic compounds with neutron irradiation, the experimental work is presented in detail. The chemical methods for determining the hydrogen content, i.e., the C/H ratio, are compared with methods based on radioisotope radiation and neutron radiation, and their applicability as process analyzers is discussed. (OID)

19905 DETERMINATION OF THE MOISTURE CONTENT OF THE SOIL AND OTHER BUILDING MATERIALS BY MEANS OF THE NEUTRON METHOD. I. THE PRINCIPLES AND DEVELOPMENT OF THE METHOD. Ljubomir Nedeljković. Tehnika (Belgrade), 18: 621-4(Apr. 1963). (In Serbo-Croatian)

The method, based on the slowing of neutrons by hydrogen nucleus, is described for determining and measuring the moisture content of soil. The experimental results obtained by French and American researchers using proper equipment and techniques are reviewed and shown to be applicable in civil engineering for practical purposes. (OID)

19906 BASIC STUDIES ON ACTIVATION ANALYSIS. I. OPTIMUM SAMPLE POSITION IN ACTIVATION ANALYSIS USING Ra–Be NEUTRON SOURCE IN PARAFFIN MODERATOR. F. Aoki and M. Okada (Government Chemistry and Industrial Research Inst., Tokyo). Tokyo Kogyo Shikensho Hokoku, 54: 121-5(Apr. 1959). (In Japanese)

The optimum distance for a specified experimental condition was reported together with the effect of the orientation of a sample surface on induced activity. It was determined on 3 samples (Ag, Rh, V) by using a Ra–Be neutron source placed in a paraffin moderator. It was found that these samples were most effectively activated by slow neutrons when they were placed at 1.7 ± 0.1 cm below the bottom of a cylindrical Ra–Be neutron source surrounded by a paraffin layer of more than 11 cm thick. As these elements used are considerably different in regard to the total neutron cross-section spectrum (cross section vs energy), the observed optimum distance seems to apply to many other elements. (auth)

19907 DETERMINATION OF OXYGEN IN RARE EARTH OXIDES AND RARE EARTH METAL FLUORIDES. G. G. Glavin and Yu. A. Karpov (State Research and Engineering Inst. of Rare Earth Industry, USSR). Zavodsk. Lab., 30: 306-8(1964). (In Russian)

Determination of oxygen in Y_2O_3, La_2O_3, CeO_2, Nd_2O_3, Pr_2O_3 and Gd_2O_3 and in YF_3 and GdF_3 was achieved by vacuum melting method using a platinum bath, graphite case, and argon chamber. The sensitivity of the method was 0.01%. (R.V.J.)

19908 POLAROGRAPHIC CATALYTIC HYDROGEN CURRENTS IN SOLUTIONS OF SOME COMPLEX COMPOUNDS AND DETERMINATION OF BERYLLIUM. V. F. Toropova and G. L. Elizarova (Kazan State Univ.). Zh. Analit. Khim., 19: 174-7(1964). (In Russian)

The reduction of nickel complexes with certain organic compounds was studied by an oscillographic polarography method. It has been shown that the catalytic activity of complexes is connected with the nature of their electroreduction. It was established that gamma amounts of beryllium can be determined by the decrease of the catalytic wave of a cobalt–8-hydroxyquinoline complex. (auth)

19909 GRAVIMETRIC DETERMINATION OF THE TOTAL RARE EARTHS IN ROCKS, MINERALS AND ALLOYS. G. M. Varshal and D. I. Ryabchikov (Inst. of Geology of Ore Deposits, Petrography, Mineralogy, and Geochemistry, Academy of Sciences, USSR and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 19: 202-7(1964). (In Russian)

A method was developed for the gravimetric determination of the total rare earths in rocks, minerals, and alloys after their preliminary chlorination by the Iordanov–Daiev method. By means of ^{144}Ce and ^{90}Y radioisotopes it was shown that when the total rare earths are separated by the suggested method the losses do not exceed 5-25% at the

rare earth content in the samples of $n \times 10^{-2} - n \times 10^{-3}$%. The gravimetric method for the determination of the total rare earths after separation of the bulk of accompanying elements by chlorination can be used for the analysis of various natural and industrial products. The advantage of this method is the possibility of reliable separtion of down to 5×10^{-4}% of the total rare earths as well as the possibility of determination of individual rare earths by the paper chromatographic and x-ray spectrographic methods. (auth)

19910 SPECTROGRAPHIC AND QUANTOMETRIC ANALYSIS OF SOLUTIONS AND SILICATE ROCKS AFTER BRINGING THE SAMPLES INTO SOLUTION. V. S. Vorobev and A. K. Rusanov (All-Union Scientific Research Inst. of Mineral Raw Materials, Moscow). Zh. Analit. Khim., 19: 286-92(1964). (In Russian)

A method is suggested for the spectrographic and quantometric analysis of industrial solutions for Be, Fe, Zr, Al, Ca, Mg, Si, Ti, and Mn, and for the analysis of silicate rocks of various composition for Si, Al, Ca, Mg, Ti, Fe, and Mn after bringing them into solution. The method is about two times more rapid than chemical methods of analysis. The reproducibility of a single determination is 2.5-5%. The distribution of errors on various stages of analysis was studied. (auth)

19911 DETERMINATION OF THE CONTENT OF INDIVIDUAL RADIOSIOTOPES IN THEIR MIXTURE BY β-RADIATION. P. N. Kodochigov and M. P. Glazunov (Inst. of Physical Chemistry, Moscow). Zh. Analit. Khim., 19: 293-6(1964). (In Russian)

The method suggested permits quantitative determination of individual radioisotopes in their mixtures without their chemical separation. The accuracy is relatively high. By combining the suggested method with the method of Fermi–Curie β-energy distribution plot it is possible to analyze mixtures of radioisotopes of unknown composition. The method can be used as an express method for determining the relative content of known radioelements in a two-component mixture. (auth)

19912 SIMULTANEOUS SPECTROGRAPHIC DETERMINATION OF ZIRCONIUM, HAFNIUM, THORIUM, AND TITANIUM IN ORES. T. M. Moroshkina and M. N. Smirnova (Leningrad State Univ.). Zh. Analit. Khim., 19: 325-7(1964). (In Russian)

A spectrographic method was developed for the simultaneous determination of Zr, Hf, Th, and Ti in natural samples. The method was tested on silicate and tantalum-niobium ores of various chemical composition, but it can be used for the analysis of other natural materials containing small amounts of the above elements. The mean experimental error is ±4–6%. The accuracy of the method is within ±10%. (auth)

19913 COLOR REACTIONS OF NIOBIUM IONS WITH CERTAIN REAGENTS CONTAINING o,o′-DIHYDROXYAZO GROUP. I. P. Alimarin, S. B. Savvin, and Yu. M. Dedkov (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, Moscow). Zh. Analit. Khim., 19: 328-36(1964). (In Russian)

Bisazo compounds on the basis of chromotropic acid, which are structurally analogous to arsenazo III, and monoazo compounds on the basis of R-salt containing o,o′-dihydroxyazo group were studied as reagents for niobium. The most contrasting reactions were observed and the most stable complexes of niobium were formed with the reagents containing $-NO_2$, $-Cl$, $-SO_3H$, and other negative groups in meta-positions to the azo group. The interaction goes on in strongly acid (1–6N with respect to HCl) mediums in the presence of tartaric acid and other complexing anions, and thus good reproducibility, reliability, and selectivity of niobium determination were achieved. An extraction-photometric method was developed based on the extraction of a diphenylguanidinium salt of the corresponding niobium complex and measuring the optical density of the extract. The method permits an essential increase in the selectivity of niobium determination. Sulfates, phosphates, chlorides, tartrates, citrates, and other anions in amounts up to 10-100 mg in 25 ml, Zr (0.2-2 mg in the presence of complexone III), Ti (2-10 mg), Ta (0.1-0.5 mg), Ca, Al a. o. (5-25 mg) do not interfere. Fluorides and especially oxalates interfere appreciably. The determinable minimum is 1-2 μg of Nb in 25 ml when bisazo derivatives of chromotropic acid are used, and 5-10 μg of Nb in 25 ml with R-salt derivatives. (auth)

19914 USE OF 1-MERCAPTOPROPIONIC ACID DERIVATIVES IN ANALYTICAL CHEMISTRY. III. 1-MERCAPTOPROPIONIC ACID AND SOME OF ITS ANILIDES AS REAGENTS FOR EXTRACTION-PHOTOMETRIC DETERMINATION OF MOLYBDENUM. A. I. Busev, A. Nacu, and G. P. Rudzit (Moscow State Univ.). Zh. Analit. Khim., 19: 337-45(1964). (In Russian)

A study was made of the interaction of Mo(V) and Mo(VI) ions with 1-mercaptopropionic acid and some of its derivatives: o- and p-phenetidide, o- and p-anisidide-, and o- and p-toluidide-1-mercaptopropionic acid. It was established that 1-mercaptopropionic acid and p-phenetidide-1-mercaptopropionic acid interact with Mo(V) and Mo(VI) ions in the ratio of 2:1. The compounds of molybdenum with p-phenetidide-1-mercaptopropionic acid are most readily extracted with a mixture of isoamyl alochol and benzene (1:1), whereas the compounds of molybdenum with 1-mercaptopropionic acid are extracted with a mixture of isoamyl alcohol and chloroform (1:1) when diphenylguanidinium or benzilthiuronium cations are present in the aqueous phase. It was established that to a complex anion of Mo(V) with 1-mercaptopropionic acid one cation is added during extraction, whereas to a complex Mo(VI) anion two diphenylguanidinium or benzilthiuronium cations are added. Extraction-photometric methods were developed for the determination of molybdenum with 1-mercaptopropionic acid and p-phenetidide-1-mercaptopropionic acid in the presence of tungsten and other elements. (auth)

19915 COPRECIPITATION OF PLUTONIUM WITH FERRIC HYDROXIDE. A. I. Novikov and I. A. Starovoit (Tadzhik State Univ., SSR). Zh. Analit. Khim., 19: 346-52(1964). (In Russian)

Precipitation of small amounts of plutonium and its coprecipitation with ferric hydroxide has a complex nature at all the valent states of plutonium studied (III, IV, VI) owing to a number of processes that take place simultaneously: oxidation and reduction, hydrolysis, complex formation, and formation of difficultly soluble compounds. Plutonium can be concentrated by coprecipitation with ferric hydroxide in a 1M solution of ammonium nitrate at pH > 6, pH > 4, and pH > 9 at its valent states III, IV, and VI, correspondingly. Iron and Pu(III) or Pu(VI) can be separated at pH 2.5-3 by the precipitation of ferric hydroxide in a 1M solution of ammonium nitrate or in a 0.5M solution of ammonium bicarbonate at pH 7.5-9. For all the valent states of plutonium studied the formation of carbonate complexes is characteristic, which leads to the decrease of precipitation and coprecipitation of plutonium. It is particularly noticeable at pH 8-9. (auth)

19916 THE LEVEL OF POLONIUM IN URINE OF JAPANESE URANIUM MINERS. T. Inouye, Y. Yamada,

and S. Akiyama (Musashi Inst. of Tech., Kawasaki, Japan). p.425-9 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Evaluation of Po in urine samples is a common bioassay method for those inhaling Ra. Polonium-210 was surveyed in the urine of people belonging to the following groups: uranium miners and mining engineers working in the U mines of the Ningyo-toge district; inhabitants living near famous hot and cold springs containing a high concentration of Ra; radium dial painters; and research workers and students. The urinalysis method developed and employed was: taking 100-ml urine sample; modulating pH of sample nearly to 0 with 20 ml of 6N HCl; depositing electrochemically on a nickel plate at 50°C during a period of 60 min (recovery rate is 50%); and counting α disintegrations on each side of plate with low-background 2-π gas-flow counter or α-scintillation counter (maximum detectable sensitivity is 10^{-15} g of ^{210}Po). In order to obtain better sensitivity, a condensing method adopting cosedimentation with 6N NaOH was developed, and the sensitivity was improved. (auth)

19917 DETERMINATION OF THORIUM IN URINE BY MEANS OF KEL-F COLUMN SUPPORTING TRI-N-OCTYLPHOSPHINE OXIDE. C. Testa (Centro Studi Nucleari Della Casaccia, Rome). p.489-501 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

In order to simplify the procedure for isolating and determining Th in urine, a very rapid and reliable chromatographic method was carried out, based on a selective adsorption of Th from a nitric medium on to a column of polytrifluorochloroethylene (Kel-F) supporting tri-n-octylphosphine oxide (TOPO). The urine, partially digested by boiling with nitric acid, is percolated through the column; in this way the majority of cations, anions, and organic matter contained in urine are eliminated; after washing with water, thorium, selectively retained from TOPO, is then eluted with diluted sulfuric or hydrochloric acid. The solution containing Th is twice evaporated to dryness and Th is finally determined colorimetrically with thoron. In order to study the column efficiency, many experiments were carried out by tracing Th with ^{234}Th (UX_1): the average recovery was 97%. The limit of error in the final colorimetric determination resulted ±10% for 5–50 μg of Th, and ±20% for 0.5–5 μg of Th; only 6 to 7 hr are necessary for the complete analysis. Some experiments were also carried out by leaving Th in the urine for several days; the same limit of error was also found in these cases. (auth)

19918 PRACTICAL COMPUTER ROUTINES FOR NEUTRON ACTIVATION ANALYSIS. D. E. Hull and J. T. Gilmore (California Research Corp., Richmond). 35p. (CONF-313-10)

From 2nd National Meeting of the Society for Applied Spectroscopy, San Diego, Calif., Oct. 1963.

A method of neutron activation analysis coupled with machine computation of the data from a pulse-height analyzer, which is capable of handling routine samples of moderately complex composition, is described. The method requires one to two hours to activate a sample and count its activity and about 5 sec per sample of computer time. The analysis of commercial lubricating oils was used in the program. (P.C.H.)

19919 SIMPLIFIED AMALGAMATION METHOD FOR THE OXYGEN EVALUATION IN SODIUM. S. Dorner and K. Kummerer (Kernforschungszentrums, Karlsruhe, Ger.). 15p. (CONF-467-2)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

In the amalgamation method a sample of the O-containing sodium is dissolved in absolutely purified Hg. After separating the Na-amalgam from the oxygen-bearing Na_2O the oxygen is determined by titration. As it is not easy to separate the amalgam and the Na_2O completely the possibility of amalgam remaining in the Na_2O must be kept in mind. Therefore, in the normally applied method a rather large amount of continuously rinsing pure Hg is necessary. In order to reduce the consumption of Hg and simplify the experimental procedure the two media are not separated in the former thoroughness. It is rather simple to measure the mercury residue in the amalgamation vessel by weighing and hence to calculate the corresponding amount of Na. This contribution is considered in the result. The experimental details are discussed. Numerical examples and an evaluation show that the errors remain within permissible limits. (auth)

19920 DETERMINATION OF ZIRCONIUM IN TANTALUM. James F. Reed (Pennsylvania State Univ., McKeesport). 6p. (CONF-48-5)

From Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1963.

The best separation of zirconium from tantalum appears to be the extraction of tantalum fluoride with methyl isobutyl ketone. Modifications of previously used conditions produced a good separation. Surprisingly, under the same conditions the separation of hafnium and tantalum is not quantitative. Zirconium is finally precipitated with ammonia in the presence of hydrogen peroxide, which complexes any remaining tantalum. (P.C.H.)

19921 APPLICATION OF CLASSICAL ANALYTICAL METHODS TO REFRACTORY METALS. J. D. Golland (National Spectrographic Labs., Inc., Cleveland). 22p. (CONF-48-6)

From Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1963.

Standard methods for the determination of Fe, Ti, Zr, Ni, and Cu in Mo, W, and their alloys are described, and data are tabulated. (P.C.H.)

19922 FAST NEUTRON ACTIVATION vs. VACUUM FUSION ANALYSIS FOR OXYGEN IN METALS. F. Burns. 9p. (CONF-313-11)

From 2nd National Meeting of the Society for Applied Spectroscopy, San Diego, Calif., Oct. 1963.

Germanium, niobium, and titanium were analyzed for oxygen both by neutron activation analysis and vacuum fusion analysis and the results were compared. Several possible sources of error were found in the activation technique. Fluorine and boron interfere in the activation analysis. The most prevalent cause of error in the vacuum fusion technique is gettering. In general, good agreement was found between the two methods of analysis. (P.C.H.)

Inorganic and Physical Chemistry

Refer also to abstracts 20287, 20525, and 20627.

19923 (AERE-M-1360) VARIATION OF SOME THERMODYNAMIC PROPERTIES ACROSS THE UC–UN SOLID SOLUTION RANGE. M. H. Rand (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Feb. 1964. 6p.

Thermodynamic calculations are presented for the stabilization of UC towards graphite by UN, the decomposition of UC–UN solid solutions to uranium and nitrogen, and the reaction of UC–UN solid solutions with nitrogen. The calculations are relevant to the preparation of UC–UN solid solutions, and their use as nuclear fuels. (auth)

19924 (AERE-R-4537) METHODS OF DECREASING THE EXTRACTION BY PROCESSING SOLVENTS OF NITROSYLRUTHENIUM NITRATO-COMPLEXES FROM NITRIC ACID SOLUTIONS. PART I. TREATMENT OF AQUEOUS SOLUTIONS WITH HYDROGEN PEROXIDE AND OZONE. C. E. Lyon and D. Scargill (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 21p.

Studies have been made of the effect of hydrogen peroxide and ozone on nitrosylruthenium nitrato-complexes in nitric acid solutions. Use of ozonised oxygen (1.5 wt. % O_3) results in the formation of ruthenium tetroxide via ruthenium(IV), and at temperatures of 20 to 40°C an equilibrium mixture corresponding to about 10% oxidation of Ru NO(III) is produced. Treatment of heated solutions with hydrogen peroxide produces an increase in the proportion of inextractable ruthenium, probably Ru(III) nitrate, followed by formation of some Ru(IV) at acidities greater than 3M HNO_3. In support of this work, the rates of oxidation of cerous nitrate by ozonised oxygen have been studied as a function of the nitric acid and silver catalyst concentrations. (auth)

19925 (AGN-8065) RUBIDIUM/CESIUM EVALUATION PROGRAM. Quarterly Progress Report, February 16–June 30, 1962. C. R. Fisher and P. Y. Achener (Aerojet-General Nucleonics, San Ramon, Calif.). July 20, 1962. Contract AT(04-3)-368. 55p.

The characteristics of rubidium and cesium at temperatures up to about 2000°F are being evaluated. Studies of boiling heat transfer and two-phase flow characteristics and measurements to determine the latent heat of vaporization, density, specific heat, viscosity, thermal conductivity, and electrical resistivity of the liquid phase of rubidium and cesium are being carried out. Design features of the heat transfer loop, and of the apparatus to be used to measure latent heat of vaporization, specific heat, and density are described. (auth)

19926 (BATT-4673-FINAL) ENGINEERING PROPERTIES OF POTASSIUM. Final Report. A. W. Lemmon, Jr., H. W. Deem, E. A. Eldridge, E. H. Hall, J. Matolich, Jr., and J. F. Walling (Battelle Memorial Inst., Columbus, Ohio). Dec. 31, 1963. Contract NAS-5-584. 85p. (NASA-CR-54017)

Many of the thermodynamic and transport properties of potassium, both liquid and vapor, have been measured for temperatures to 2100°F. Experimental values for vapor pressure; specific heat, thermal conductivity, and viscosity of liquid; and P-V-T characteristics have been obtained. Experimental techniques for the direct measurement of the specific heat of potassium vapor and for the measurement of its viscosity and thermal conductivity have also been explored and developed. The latent heat of vaporization, and enthalpy, entropy, and specific heat of potassium vapor have been computed from some of the data obtained. (auth)

19927 (CONF-322-9) THE USE OF FLASH HEATING TO STUDY THE COMBUSTION OF LIQUID METAL DROPLETS. Lloyd S. Nelson and Norman L. Richardson (Sandia Lab., Albuquerque, N. Mex.). [1963]. Contract [AT(29-1)-789]. 10p.

From the American Chemical Society, Production Technology of NP-237 and Pu-238, Denver, Jan. 1964.

The use of flash heating to form single droplets of molten Zr (melting point 1855°C) with highly reproducible diameters between 100 and 500 μ is reported. The droplets were prepared from carefully cut squares of foil (dimensions: 0.2 to 2.0 mm^2, 16 μ thick). Oxidations were performed in air at pressures between 50 and 629 Torr. The most impressive feature of the combustion of a Zr droplet falling freely in air is the explosion or sparking that occurs a short time after the droplet is formed. Speculation is given as to the cause of the explosion. (P.C.H.)

19928 (CONF-405-6) THERMODYNAMICS OF LANTHANUM AND NEODYMIUM HEXABORIDES. E. F. Westrum, Jr., H. L. Clever, J. T. S. Andrews, and G. Feick (Michigan. Univ., Ann Arbor. Dept. of Chemistry). [1963]. Contract AT(11-1)-1149. 14p.

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

Heat-capacity measurements on massive zone-refined samples of lanthanum and neodymium hexaborides have provided further elucidation of the behavior of two important members of the magnetically concentrated lanthanide alloys with high metallic conductivity. Because of its diamagnetic nature, no thermal anomalies were found in LaB_6 from 5 to 350°K and the relevant thermodynamic properties at 298.15°K may be summarized as 23.17, 19.88, and 8.700 cal/(gfm) °K) for the heat capacity at constant pressure (C_p), the entropy ($S°$), and the Gibbs energy function $-(F°-H°_0)/T$, respectively. Although NdB_6 with its two 4f electrons on the Nd atom appears to be a well-behaved Curie-Weiss paramagnetic with a magnetic susceptibility of about 3×10^{-3} at 300°K, the true Curie-Weiss temperature appears to be well below 100°K. A cooperative lambda-type transition suggestive of ferro- and antiferromagnetic ordering with a Néel temperature near 7.5°K was observed. Resolution of the excess heat capacity by using the lattice contributions of the isostructural lanthanum hexaboride indicates the presence of a complex Schottky transition with a maximum near 50°K presumably occasioned by crystalline field splitting. (auth)

19929 (CONF-417-20) CALCULATION OF HEAT CAPACITIES AND COMPRESSIBILITIES OF LIQUIDS FROM A RIGID SPHERE EQUATION OF STATE. S. J. Yosim (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [1963]. Contract AT-11-1-GEN-8. 30p.

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

Equations for heat capacities and compressibilities of liquids were calculated by differentiation of the expression for the entropy of a fluid of rigid spheres. The resulting equations contain no adjustable parameters. The information required in addition to the heat capacity and compressibility of the gas, is the diameter of the molecule, the liquid density, and its variation with temperature. The equations were applied to the rare gases and to diatomic and polyatomic molecules at their boiling points. Agreement between the calculated and observed values was with few exceptions very good. Further, the calculated temperature dependence showed good agreement with experimental values. This treatment was also extended to solid Ar and yielded excellent results for the heat capacity. (auth)

19930 (COO-1044-12) ELECTRICAL CONDUCTIVITY OF POTASSIUM THIOCYANATE (thesis). Special Report

No. 1. Juan M. Lomelin (Illinois Inst. of Tech., Chicago). June 1959. Contract AT(11-1)-1044. 53p.

The d-c conductivity of KCNS was measured as a function of temperature is purified and barium doped polycrystalline samples. From these data it was calculated that intrinsic conductivity is given by the equation $G = 10^{18.6} \exp(-24850/T)$ mhos cm^{-1} and the activation energy of intrinsic conductivity ($\frac{1}{2}E_f + E_d$) was found to be 2.08 ev. The enhancement of G resulting from doping with Ba^{2+} and the fact that no changes in G occurred from doping with S^{2-} indicate that the mobility of positive ion vacancies is several orders of magnitude higher than that of negative ion vacancies. From the temperature dependence of the conductivity in the structure sensitive region, the activation energy of diffusion (E_d) for positive ions vacancies was calculated to be 1.27 ev. The conductivity properties of KCNS are not in agreement with a tentative equation which was intended to relate the activation energy of intrinsic conductivity for ionic crystals with their melting temperatures. This disagreement is apparently explained by differences in crystalline structure. (auth)

19931 (EUR-542.e) ELECTRON MICROSCOPE STUDY OF INTERLAMELLAR COMPOUNDS OF GRAPHITE WITH BROMINE, IODINE MONOCHLORIDE AND FERRIC CHLORIDE. S. Amelynckx, P. Delavignette (Centre d'Etude l'Energie Nucleaire, Brussels); and M. Heerschap (European Atomic Energy Community). 1964. 37p. (CONF-73-22)

From the 6th Biennial Conference on Carbon, Pittsburgh, June 1963.

Evidence is given of the existence of isolated dislocations in graphite-bromide and graphite-iodine monochloride, which are bounding the intercalated reactant layers. These boundary dislocations show stacking fault contrast to one side. The basal component of the Burgers vector lies along one of the three projections of the $\{11\bar{2}0\}$ planes on the basal plane, compatible with the Burgers vectors of normal partial dislocations. It is therefore thought that the carbon hexagon networks on either side of a reactant layer are shifted in identical positions. Evidence is further given of a mechanism by which moving boundary dislocations leave numerous loops of occluded reactant behind on their way through the crystal. The islands of occluded reactant may account for at least part of the residual reactant retained in the crystal upon decomposition. Investigated and discussed are interactions of a boundary dislocation and a normal dislocation ribbon as well as the widening of dislocation ribbons presumably by preferential diffusion of reactant along the ribbon. The situation in the graphite-ferric chloride compound proved to be more complicated and the results not consistent. Evidence is given of isolated dislocations, which show no stacking fault contrast at one side. They separate however regions, resembling normal graphite, where normal dislocation ribbons are still present from regions where the contrast of the partials has become more diffuse, the partial dislocations assuming equidistant positions. It is therefore thought that these dislocations bound the intercalated ferric chloride layers. The widening of the contrast of the partials and their behavior upon intercalation of $FeCl_3$ is interpreted as a result of the expansion of the interlayer spacing. (auth)

19932 (KY-453) PLASMA TORCH PRODUCTION OF ELEMENTAY BORON. G. E. Biggerstaff, W. R. Golliher, R. L. Harris, and W. R. Rossmassler (Paducah Gaseous Diffusion Plant, Ky.). Feb. 26, 1964. Contract W-7405-eng-26. 42p.

A feasibility study was made on the production of elemental boron by the reduction of BF_3 and BCl_3 in a plasma system. The study was successful in producing elemental boron from both boron halides. The maximum yields obtained per pass through the torch were 30% with BF_3 and 60% with BCl_3. The chemical purity of the boron produced was as high as 94.6% with BF_3 and 99.1% with BCl_3. The major impurities were nitrogen and oxygen which originated as contamination in the feed and plasma gases. Results indicate that further development could lead to a commercially feasible process. (auth)

19933 (NP-13862) CALCULATION OF THE VAPOR PRESSURE AND HEATS OF VAPORIZATION AND SUBLIMATION OF LIQUIDS AND SOLIDS, ESPECIALLY BELOW ONE ATMOSPHERE. V. CARBON MONOXIDE AND CARBON DIOXIDE. Technical Report No. 2. J. C. Mullins, B. S. Kirk, and W. T. Ziegler (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). Aug. 15, 1963. Contract CST-7404. 87p.

The vapor pressure and heats of vaporization and sublimation of carbon monoxide have been computed at one degree intervals from the normal boiling point (81.638°K) to 14°K. The vapor pressure and heats of sublimation of carbon dioxide have been computed at one degree intervals from the normal sublimation temperature (194.694°K) to 40°K. The agreement obtained between the computed and experimental vapor pressure data for carbon monoxide in the liquid and solid region down to the solid transition point (61.544°K) suggests that the computed values may well represent the experimental data within the accuracy of the temperature scales used by the various investigators. The computed values of the vapor pressures are therefore recommended for use as smoothed values, especially below the solid transition temperature where the limited experimental data are scattered and discordant. For carbon dioxide the computed values of the vapor pressures agree well with the best experimental data which have been obtained on the thermodynamic scale. The experimental data measured on the International Temperature Scale appeared to deviate in a manner which is consistent with the available known deviations of the International Temperature Scale from the thermodynamic scale. The values of the vapor pressure of carbon dioxide computed at one degree intervals are therefore recommended as a consistent set of values on the thermodynamic temperature scale. (auth)

19934 (NP-13874) STUDIES IN ULTRAFILTRATION WITH METAL MEMBRANES (thesis). William Carey Skinner (Vanderbilt Univ., Nashville). [1949]. 78p.

A study was made of preparation of porous silver membranes by chemical attack on the zinc of a silver–zinc alloy. This procedure was standardized so that results are readily reproducible, and membranes of uniform properties are produced. The density of the finished membranes is that of bulk silver, and it has been demonstrated that the chemical attack terminates at a point corresponding approximately to exhaustion of the zinc content of the alloy. Liquid flow rates through these membranes are high enough to make their use practical for filtration studies, even when very small driving pressures are used. When a calculation is made in the usual way for the ideal membrane with straight, cylindrical pores, having the same permeability to water flow and the same void fraction as the experimental silver membranes, the resulting pore diameter is on the order of 900 Angstrom Units. The effective filtration pore diameter of these silver membranes was determined by means of a series of gold hydrosols of graded particle size. Adsorption interference

with this determination was suppressed by the procedure of satisfying adsorption demand with a gold hydrosol of particle size an order of magnitude less than the pore diameter. The effective pore diameter for filtration was found to be 700 Angstrom Units or less. There is some evidence, incomplete in nature, for an effective pore diameter for filtration on the order of 500 Angstrom Units. Experimental constants of ultrafilters were defined, and experimental details are given for all procedures of manufacture and testing. (auth)

19935 (TID-18814) SPECTRA OF UCl_4 IN ORGANIC SOLUTIONS. D. G. Karraker (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [June 1963]. Contract AT(07-2)-1. 11p.

The absorption spectra of UCl_4 in 1M HCl, 12M HCl, methanol, ethanol, isopropanol, tetrahydrofuran (THF) and tri-n-butyl phosphate (TBP) exhibit wide variations in the intensity and location of major absorption bands. The spectra are qualitatively interpreted as the result of activation of "forbidden" transitions in the $5f^2$ configuration by the different solvents. Activations of the same bands by ligands of different character, such as chloride and ethanol, were observed, and it is proposed that spectra in mixed THF-methanol solutions indicate activation of different bands by different species in the coordination sphere. (auth)

19936 (TID-20485) A GENERAL EQUATION FOR THE CURRENT-POTENTIAL RELATIONSHIPS AT A ROTATING DISC ELECTRODE. Report No. 83. Ilana Fried and Philip J. Elving (Michigan. Univ., Ann Arbor). Feb. 28, 1964. Contract AT(11-1)-1148. 23p.

The existing theoretical treatments of the rotating disk electrode are examined to determine their usefulness for actual electrochemical investigation, and an equation is derived which describes the complete current-potential curve obtained under standard voltammetric conditions: potential varying linearly with time and current varying as a function of potential. The treatment used assumes that the electrode reaction is reversible and controlled by the rate of mass transport and that an excess of nonelectroactive electrolyte is present. The treatment does not presuppose any particular mechanism for the electrode reaction. (auth)

19937 (TID-20514) SOLID STATE SPECTROSCOPY: INFRARED ABSORPTION OF DECABORANE (thesis). David T. Somerville (Michigan State Univ., East Lansing). 1963. Contract [AT(11-1)-400]. 89p.

The infrared absorption spectrum of decaborane ($B_{10}H_{14}$) was studied in the sodium-chloride range (4000–667 cm^{-1}) in the vapor, in solution, and in the solid. Particular attention was paid to the changes in the absorption spectrum near 2600 cm^{-1}, the region of absorption corresponding to the stretching mode of singly-bonded hydrogen atoms in the decaborane molecule. The spectra in the vapor and in solution were obtained by standard techniques. For the solid, various methods were tried; pelleting and evaporation gave suitable spectra. The detailed molecular and crystal structure of decaborane is described in order to provide a basis for interpreting the changes in the spectrum in going from one phase to another. A rise in transmission just before an absorption maxima was interpreted in terms of the Christiansen Filter effect. Tentative explanations are given for the appearance of a shoulder on the 2600 cm^{-1} absorption band, and for the doubling of this absorption band upon condensation of the molecules into the solid. Identification of the two minima of the doublet is based on the atomic environment of the terminal hydrogens of the molecule. Analysis of the line shape on the basis of a damped harmonic oscillator is promising for the dilute-phase spectra, but impracticable for the solid-state spectra because of the splitting of the line. (auth)

19938 (UCRL-11252) THE REACTION OF FERRICYANIDE WITH BOROHYDRIDE IN AQUEOUS SOLUTION (thesis). Lydia S. Hsu (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Jan. 1964. Contract W-7405-eng-48. 26p.

The kinetics of the reaction of ferricyanide with borohydride (in the concentration ranges for both reactants of 0.1–0.5M) has been studied in alkaline aqueous solution at room temperature. The reaction was found to be catalyzed by glass surfaces. This catalysis, however, can be avoided by using wax-coated-surfaces. The rate of change of the hydroxide ion concentration was found to be first order in both ferricyanide and borohydride and independent of the hydroxide ion, at least in the high pH region, with a rate constant of $4.93 \times 10^{-4} M^{-1}$ min^{-1}. This result is different from that found by Freund for very dilute ferricyanide and borohydride ion in buffered aqueous solution. Under the conditions of Freund's experiments, no glass catalysis was observed. (auth)

19939 (WADD-TR-60-782(Pt.XXI)) VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXI. MASS SPECTROMETRIC STUDIES OF THE VAPORIZATION OF THE SULPHIDES OF CALCIUM, STRONTIUM AND BARIUM. THE DISSOCIATION ENERGY OF S_2 AND SO. R. Colin, P. Godlfinger, and M. Jeunehomme (Brussels. Universite). Feb. 1964. Contract AF61(052)-225. 34p.

CaS, SrS, and BaS have been evaporated and the vapor analyzed by mass spectrometry. The following thermochemical data were obtained: $D^\circ_0(S_2) = 97 \pm 5$; $D^\circ_0(CaS) = 73.7 \pm 4.5$; $D^\circ_0(SrS) = 74.1 \pm 4.5$; $D^\circ_0(BaS) = 94.7 \pm 4.5$; $\Delta H(dim.BaS) = 113.9 \pm 5$; $\Delta H_{298\,vap}(CaS) = 148.0 \pm 5$; $\Delta H_{298\,vap}(SrS) = 143.0 \pm 5$; $\Delta H_{298vap}(BaS) = 122.5 \pm 5$; $D^\circ_0(CaO) = 84.4 \pm 6$; $D^\circ_0(SrO) = 92.2 \pm 6$; $D^\circ_0(BaO) = 130.4 \pm 6$; $D^\circ_0(SO) = 123.5$ kcal per mole. (auth)

19940 (SC-T-64-613) CONCERNING THE ADSORPTION OF RADON ON ACTIVATED CHARCOAL AND SILICA-GEL. O. Guebeli and K. Stammbach. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Helv. Chim. Acta, 34: 1257-43(1951). 9p.

The mixed adsorption of radium emanation (radon) with air as a carrier gas for the adsorbents silica gel and linden wood charcoal was investigated. At equal temperatures, the linden wood charcoal proves to be considerably more active than silica gel. The experimental data allow one to calculate the isosteric adsorption heats for both adsorption agents. (auth)

19941 A CRYSTALLOGRAPHIC STUDY OF $Nb_2O_5 \cdot 3WO_3$. Ganesh P. Mohanty and Leon J. Fiegel (A. O. Smith Corp., Milwaukee). Acta Cryst., 17: 454(Apr. 10, 1964).

Diffraction studies of the single crystals $Nb_2O_5 \cdot 3WO_3$ in a precession camera confirmed the unit cell as tetragonal. The unit-cell dimensions derived from the precession photographs are $a = 12.130 \pm 0.002$, $c = 3.936 \pm 0.002$ Å. Using loose powder samples of the compound, an approximate pycnometric density of 5.3 cm^{-3} corresponding to two formula weights per cell (calculated density: 5.51 g cm^{-3}) was obtained. From single-crystal photographs, the Laue symmetry of the compound is 4/mmm. Powder diffraction data are tabulated. (P.C.H.)

19942 TETRAGONAL PHASES OF THE GENERAL TYPE $10M_2O_5 \cdot 90M'_2O_5$ APPARENTLY ISOSTRUCTURAL WITH $Ta_2O_5 \cdot 2Nb_2O_5$. J. L. Waring and R. S. Roth (National Bureau of Standards, Washington, D. C.). Acta Cryst., 17: 455-6(Apr. 10, 1964).

An investigation was made to determine whether or not tetragonal phases occur in binary systems. Phases were identified by x-ray diffraction at room temperature. The results show that 10 mole % P_2O_5, As_2O_5, or V_2O_5 when added to 90 mole % of either Nb_2O_5 or Ta_2O_5 gives x-ray diffraction patterns that could be indexed on a tetragonal cell. A similar tetragonal phase also forms when 10 mole % GeO_2 are added to Nb_2O_5, but not in the GeO–Ta_2O_5 system. Powder data of these tetragonal phases appear to indicate that they are isostructural with the Ta_2O_5–$2Nb_2O_5$ system. Data are tabulated. (P.C.H.)

19943 THE EFFECT OF A NUMBER OF HALIDE COMPOUNDS ON THE OXIDATION OF U(IV) IN SULFURIC ACID. G. M. Nesmeyanova and A. I. Vikulov. At. Energ. (USSR), 16: 130-4(Feb. 1964). (In Russian)

Samples of UO_2 were oxidized by MnO_2 and $(NH_4)_2S_2O_8$ in the presence of NaF, NaCl, NaBr, and NaI as catalysts. On adding 1.2 to 3.6×10^{-2} gram-ion of the halide per gram-ion of uranium in 0.2N H_2SO_4, the addition of fluoride ion gave a sharp increase in the dissolution of U(IV) dioxide not only in air, but also in nitrogen. The complexing ability of the fluoride ion accelerated the dissolution of UO_2. Since SO_4^{2-} ions were present in solution, complexes such as $H_2[U(SO_4)_2F_2]$ could be formed as follows: $U^{4+} + 2SO_4^{2-} + 2H^+ + 2F^- \rightleftharpoons 2H^+ + [U(SO_4)_2F_2]^{2-}$. The higher the concentration of F^- or I^- in solution, the more complete was the dissolution of UO_2. Thus, UO_2 was completely dissolved by ammonium persulfate at 90°C in a period of 3 hours in the presence of 10% fluorine (based on the weight of UO_2). On adding $CuSO_4$ as a catalyst, the oxidation of UO_2 by ammonium persulfate and by oxygen of the air was 92% after 3 hours in an acid medium. The oxidation of UO_2 was slowed down when copper was added as a citrate complex. The addition of the copper complex $Na_2[CuCl_4]$ gave 78.5% oxidation compared to 85.5% oxidation of UO_2 by $CuSO_4$. (TTT)

19944 CALCIUM AND ZIRCONIUM PHOSPHATE: PREPARATION AND CRYSTALLOGRAPHIC CHARACTERISTICS. Carlo Bettinali, Aldo La Ginestra, and Mario Valigi (Universita, Rome). Atti. Acad. Nazl. Lincei, Rend., Classe Sci. Fis., Mat. Nat. (8), 33: 472-6(Dec. 1962). (RT/CHI(63)33). (In Italian)

The compound $CaZr(PO_4)_2$ was prepared, and the reticular constants were determined. Its cell is monoclin, with $a_0 = 9.966$ (±0.009); $b_0 = 8.774$ (±0.005); $C_0 = 8.323$ (±0.004) Å; $\beta = 114° 4' 40''$. (auth)

19945 PARAMAGNETIC RESONANCE OF Gd^{3+} IN ZIRCON. D. R. Hutton and G. J. Troup (Monash Univ., Victoria, Australia). Brit. J. Appl. Phys., 15: 405-6 (Apr. 1964).

The fine structure parameters, linewidths, spin-lattice relaxation times, and hyperfine constants are reported for trivalent gadolinium, present as an impurity in single crystals of the tetragonal mineral zircon. (auth)

19946 THE SYNTHESIS OF CHELATING AGENTS. II. THE SYNTHESIS OF AMINOACETONE-N, N-DIACETIC ACID AND ITS CHELATING BEHAVIOR WITH METAL IONS. Takeshi Ando (Kyushu Univ., Fukuoka). Bull. Chem. Soc. Japan, 36: 1593-9(Dec. 1963).

Aminoacetone-N,N-diacetic acid or 1-amino-2-propanone-N,N-diacetic acid was synthesized. This is the first iminodiacetic acid derivative to have a keto group as an additional coordinating site. The acid dissociation constant and the chelate stability constants of this ligand were determined by the pH titration method, at 25°C and 0.10M ionic strength, for such metal ions as copper(II), lead(II), nickel(II), zinc(II), cadmium(II), cobalt(II), calcium(II), strontium(II), and magnesium(II). It was proved that the coordination of the carbonyl oxygen of this ligand to metal ions is appreciable, and the increase in the chelate stability is explained by the contribution of the carbonyl coordination. (auth)

19947 STUDIES ON THE COMPLEX FORMATION BETWEEN URANIUM AND THIOMALIC ACID. V. K. Mathur, H. L. Nigam, and S. C. Srivastava (Univ. of Allahabad, India). Bull. Chem. Soc. Japan, 36: 1658-61(Dec. 1963).

Uranyl ion was found to form an orange-yellow colored complex with thiomalic acid. Spectrophotometric measurements reveal a composition of 1:1 as UO_2(II):TMA in the complex, where TMA stands for thiomalic acid. Thiomalic acid is found to behave as a bidentate ligand with UO_2(II) in this complex. This was concluded by a potentiometric method. Magnetic susceptibility measurements, however, show an anomalous magnetic behavior. The formation constant log K, at fixed pH and ionic strength as calculated from the spectrophotometric curves, comes out to be 3.0 ± 0.1 and the corresponding free energy of formation was calculated as −4.2 ± 0.2 at 25°C. (auth)

19948 COMPOSITION OF THE SCANDIUM AND RARE EARTH COMPLEXES OF ARSENAZO. Hiroshi Onishi and Hitoshi Nagai (Japan Atomic Energy Research Inst., Tokyo). Bunseki Kagaku, 13: 199-202(Mar. 1964). (In Japanese)

The empirical formula of the scandium(III) complex with arsenazo in solution was established by three spectrophotometric techniques: mole ratio method, continuous variation method, and slope ratio method. It is indicated that at pH 6.1(0.1M in acetate) the complex is formed by one mole of scandium reacting with one mole of arsenazo (R), giving the empirical formula as ScR. The results of the continuous variation method indicate that at pH 7.2 (0.1M in triethanolamine) arsenazo forms 1 to 1 complexes with the rare earths. Lanthanum(III), cerium(III), and ytterbium(III) were used. (P.C.H.)

19949 INCORPORATION OF STRONTIUM INTO PRECIPITATES OF CALCIUM FLUORIDE AND CALCIUM PHOSPHATE. Sheilagh A. Cameron, June M. Heil, and O. G. Holmes (Univ. of Saskatchewan, Saskatoon). Can. J. Med. Technol., 23: 28-9(Mar. 1961).

Experiments on the coprecipitation of Sr^{2+} with Ca^{2+} in precipitates of CaF_2 and $CaHPO_4$ are reported. Trace amounts of Sr^{2+} present during partial precipitation of Ca^{2+} by fluoride and phosphate were determined. An aqueous solution of $CaCl_2$ and $SrCl_2$ (Sr^{90} + carrier) was prepared that contained 100 mg Ca^{2+} and 1 mg Sr^{2+} in 18 ml. To this was added 5 ml of NaF solution, which contained enough F^- to precipitate slightly more than ½ of the Ca^{2+}. The precipitation was performed rapidly with vigorous agitation at room temperature, and the precipitate was isolated by centrifugation and the decantate assayed for Ca^{2+} and Sr^{2+}. The phosphate precipitation was carried out similarly using a solution of Na_2HPO_4. It was shown that when about ½ of the Ca^{2+} was precipitated as CaF_2, only a slightly smaller fraction of the Sr^{2+} was coprecipitated. For CaF_2 and SrF_2 the solubility products (K_{sp}) are 3.9×10^{-11} and 3×10^{-9}. For a solution containing Ca^{2+}, Sr^{2+}, and F^- in equilibrium with pure CaF_2 and pure SrF_2, the ratio of Sr^{2+} concentration to Ca^{2+} should be the same as the ratio of K_{sp}'s, or 77 to 1. This means that under equilibrium conditions, Sr^{2+} should begin to precipitate only

when the Ca^{2+} concentration has been reduced to $1/_{77}$ that of Sr^{2+}. The discrepancy between the calculated and observed precipitation of Sr^{2+} arises because: equilibrium conditions were not attained during the rapid precipitation; and the solid phase was a double salt of SrF_2 and CaF_2, not the pure salts. For $CaHPO_4$, $K_{sp} = 5 \times 10^{-6}$, while $SrHPO_4$ is insoluble. It was shown that Sr^{2+} concentrates in the phosphate precipitate, as expected from the solubilities. If the weight of Sr^{2+} per g Ca^{2+} is used as a measure of Sr^{2+} concentration, during the fluoride precipitation the Sr^{2+} was enriched in the decantate by a factor of $12.9 \times 10^{-3}/7.9 \times 10^{-3} = 1.6$. During the phosphate precipitation the Sr^{2+} was concentrated in the precipitate by a factor of $13.7 \times 10^{-3}/5 \times 10^{-3} = 2.7$. It was concluded that, for the concentrations and conditions used, Sr^{2+} shows over a 4-fold tendency to coprecipitate into $CaHPO_4$ rather than CaF_2. (BBB)

19950 THE REACTION OF ALUMINUM CHLORIDE WITH BERYLLIUM CHLORIDE. K. N. Semenenko, T. N. Naumova, L. N. Gorokhov, and A. V. Novoselova (Moscow State Univ.). Dokl. Akad. Nauk SSSR, 154: 648-9(Jan. 21, 1964). (In Russian)

A phase diagram is presented for the $AlCl_3-BeCl_3$ system on the basis of x-ray and thermographic analysis. A eutectic occurs at a temperature of 90 to 100°C with a composition of 52 mole % $BeCl_2$. Two solid solutions similar in structure to pure $AlCl_3$ (α-phase) and $BeCl_2$ were observed by x-ray analysis at high $AlCl_3$ and $BeCl_2$ concentrations. On forming a solid solution of $BeCl_2$ in $AlCl_3$, the aluminum showed a tendency for octahedral coordination of the chlorine atoms. A mass-spectrometric study of the vapor over a fused salt mixture containing 35 mole % $BeCl_2$ showed the existence of the addition compound $BeCl_2 \cdot AlCl_3$. Aluminum chloride reacted at 140°C with beryllium chloride to form the bridge molecule $AlBeCl_5$. The ions $BeAlCl_4^+$ and $BeAlCl_3^+$ were observed in the mass-spectrometer. This reaction is of theoretical interest because of the similarity of the crystal lattices of $AlCl_3$ and $BeCl_2$. (TTT)

19951 ATTEMPTS AT CALCULATION OF KINETIC ISOTOPE EFFECTS. I. A SIMPLE METHOD FOR CALCULATION OF THE VIBRATION FREQUENCIES OF MOLECULAR AND TRANSITION STATES AND ITS USE ON THE IONS H_3O^+ AND D_3O^+ AS EXAMPLES. A. V. Willi (Universität, Bern). Helv. Chim. Acta, 47: 647-54(1964). (In German)

For a theoretical estimation of kinetic isotope effects, vibration frequencies of initial and transition states must be known. A method was developed for the calculation of vibration frequencies of polyatomic particles with the aid of an electronic digital computer. The problem is formulated in terms of cartesian displacement coordinates. After a few transformations, a symmetrical matrix is obtained whose eigenvalues may readily be calculated by application of a special iterative program. Factoring of the matrix in a preceding step can thus be avoided. The method was applied for the calculation of the vibration frequencies of the ions H_3O^+ and D_3O^+ as examples. (auth)

19952 ATTEMPTS AT CALCULATION OF KINETIC ISOTOPE EFFECTS. II. A FOUR-CENTER MODEL OF TRANSITION STATES FOR ACID CATALYZED WATER ADDITION TO OLEFINS. A. V. Willi (Universität, Bern). Helv. Chim. Acta, 47: 655-61(1964). (In German)

The method of calculating vibrational frequencies to determine isotope effects was applied to the transition state of the acid-catalyzed olefin hydration. From different sets of force constants, vibration frequencies and partition function ratios were computed for a cyclic four-center model composed of olefin + $H^+ \cdot OH_2$ or olefin + $D^+ \cdot OD_2$. Tunneling corrections were calculated with the aid of Bell's formula. A semiempirical value was used for Q_{D_3O}/Q_{H_3O}. It is shown that for the four center transition state the isotope effect k_H/k_D may be in the order of 1.1 to 1.6. (auth)

19953 MICROHARDNESS OF CRYSTALS OF NATURAL ZIRCON ($ZrSiO_4$). V. A. Ermolaev and A. M. Kuz'min (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 63-8(1964). (In Russian)

The results of an investigation of the microhardness of zircon crystals are discussed. The reason for the variation of microhardness on different facets of the crystal is considered. (tr-auth)

19954 PREPARATION AND PROPERTIES OF TWO STRONTIUM ORTHOPHOSPHATES—$Sr_3(PO_4)_2 \cdot 4H_2O$ AND $Sr_6H_3(PO_4)_5 \cdot 2H_2O$. Robert L. Collin (New England Deaconess Hospital, Boston). J. Chem. Eng. Data, 9: 165-6 (Apr. 1964).

Two new strontium orthophosphates were prepared by precipitation from aqueous solution at room temperatures or below. $Sr_3(PO_4)_2 \cdot 4H_2O$ was prepared by adding a $Sr(NO_3)_2$ solution to a solution containing an excess of K_2HPO_4 and made basic with KOH. This new compound, a gelatinous material, appears to have a layer structure. $Sr_6H_3(PO_4)_5 \cdot 2H_2O$ was prepared by adding a $Sr(NO_3)_2$ solution to a KH_2PO_4 solution, which had been adjusted to pH 7.7. X-ray diffraction data are reported for both compounds. (auth)

19955 THERMODYNAMIC PROPERTIES OF INORGANIC SUBSTANCES. VII. THE HIGH TEMPERATURE HEAT CONTENT OF ZIRCONIUM DIBORIDE. Robert H. Valentine, Thomas F. Jambois, and John L. Margrave (Univ. of Wisconsin, Madison). J. Chem. Eng. Data, 9: 182-4(Apr. 1964).

The high temperature heat content of a high-purity sample of ZrB_2 was measured in a copper-block drop calorimeter over the range 410 to 1125°K, and the results correlated with low temperature heat capacity data on a similar sample. Derived thermodynamic properties over the range 0 to 2000°K are presented based on experimental data up to 1200°K and on extrapolations of computer-selected fits of the experimental points. (auth)

19956 THERMODYNAMIC PROPERTIES OF Pu^{239} AS AN IDEAL GAS. Arnold Benton (Argonne National Lab., Ill.). J. Chem. Eng. Data, 9: 198-9(Apr. 1964).

Thermodynamic properties of ^{239}Pu, based on 32 energy levels from 0.0 to 27,651.22 cm^{-1}, to 5000°K are tabulated. (P.C.H.)

19957 MICROWAVE ABSORPTION AND MOLECULAR STRUCTURE IN LIQUIDS. LVI. DIELECTRIC BEHAVIOR OF WATER AND HEAVY WATER IN DIOXANE. Colin J. Clemett, Edward Forest, and Charles P. Smyth (Princeton Univ., N. J.). J. Chem. Phys., 40: 2123-8(Apr. 15, 1964).

The dielectric constants and losses of seven water–dioxane mixtures and six heavy-water–dioxane mixtures ranging in concentration from 5 to 58 mole % of water were measured at wavelengths from 0.44 to 10.0 cm. The results are interpreted in terms of two partly superimposed noninteracting Debye dispersions. The high-frequency dispersion region for the water–dioxane mixtures corresponds to a relaxation time 4×10^{-12} sec, which is concentration independent, while the low-frequency dispersion region corresponds to a relaxation time that is concentration dependent and rises to a maximum at about

70 to 80 mole % water. The relaxation time 5.6×10^{-12} sec associated with the high-frequency dispersion region of the heavy-water–dioxane mixtures differs from the corresponding relaxation time for water-dioxane mixtures by a factor of $(\frac{1}{2})^{\frac{1}{2}}$. The low-frequency concentration-dependent relaxation time was found to be about 1.2 to 1.5 times greater than the corresponding relaxation time of the water–dioxane system. The high-frequency dispersion region is attributed either to the rotation of the OH (or OD) group about its hydrogen (or deuterium) bond or to overall molecular relaxation. The low-frequency dispersion is attributed to the partial breaking and reforming of the hydrogen (or deuterium) bond. The rotational mechanism becomes a molecular libration in the extrapolating to pure water and contributes to the large atomic polarization observed. (auth)

19958 PERTURBED HARTREE-FOCK CALCULATIONS. II. FURTHER RESULTS FOR DIATOMIC LITHIUM HYDRIDE. Richard M. Stevens and William N. Lipscomb (Harvard Univ., Cambridge, Mass.). J. Chem. Phys., 40: 2238-47(Apr. 15, 1964).

Previous calculations for the susceptibility and shielding of lithium hydride are extended and refined. It is shown that the basis sets for the first-order wavefunction are invariant under small variations of the other parameters and that the basis sets used in the final calculations are essentially complete. Results from calculations at three internuclear distances yielded vibrational corrections. The computed rotational magnetic moment is −0.667 nuclear magnetons, and the computed spin rotational constants of lithium and hydrogen are +9.45 and −9.38 kc/sec, respectively, in substantial agreement with experiment. The method is also applied to the perpendicular component of the electric polarizability, which has a calculated value of 4.063 Å^3. (auth)

19959 STATISTICAL MODEL FOR THE BETA ZIRCONIUM HYDRIDES. Thomas B. Douglas (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 40: 2248-57(Apr. 15, 1964).

It appears reasonable to consider the hydrogen as bonded covalently to zirconium in the zirconium hydrides. After consideration of the known structure of ZrH_2, the hypothesis is made that the nonstoichiometric beta (bcc) Zr–H phases have four symmetrical (tetrahedral) hydrogen sites on each face of the unit cell, with simultaneous occupancy restricted to pairs not closer than the shortest H–H distance in ZrH_2. The complex configurational problem is solved for all concentrations by developing a simple process of building up the lattice, after making tests of the amount of detail required for accurate solutions in one and two dimensions. The total entropy, when decreased by the corresponding configurational entropy, corresponds to values of the hydrogen vibration frequency averaging 1440 cm^{-1} and showing no consistent trend with temperature or with a fourfold change in hydrogen concentration. A semi-empirical energy model is constructed by introducing the hypothesis that zirconium bonded to no hydrogen is abnormally stable, and the two energy parameters are derived from the experimental data. The agreement with the curves derived from thermodynamic data is fairly good for the partial molal entropy and energy of hydrogen, and excellent for the hydrogen equilibrium pressures. Alternative models, however, are not eliminated unambiguously. (auth)

19960 CALCULATION OF CHEMICAL SHIFTS. II. THE XENON FLUORIDES. Cynthia Juan Jameson and H. S. Gutowsky (Univ. of Illinois, Urbana). J. Chem. Phys., 40: 2285-93(Apr. 15, 1964).

Xenon chemical shifts in the xenon fluorides XeF_2, XeF_4, XeF_6, and $XeOF_4$ were calculated by means of the general methods previously presented. Comparisons with the experimental chemical shifts show that the change in $\sigma^{(2)}$, the paramagnetic contribution, is the dominant term and that a localized description using spd hybrid zenon orbitals gives better agreement with experiment than a delocalized MO description using no d hybridization. In addition, the indirect Xe–F and Xe–O coupling constants observed in XeF_2, XeF_4, and $XeOF_4$ are more consistent with the localized models. The fluorine chemical shifts were used to estimate the ionicity of the Xe–F bonds. Also, a comparison of the anisotropy predicted for the fluorine shift in XeF_4 with an experimental value shows that the fluorine shifts result almost entirely from differences in $\sigma^{(2)}$. (auth)

19961 QUANTUM ISOTOPE EFFECT IN PERMEATION. H. L. Frisch and C. E. Rogers (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Chem. Phys., 40: 2293-8(Apr. 15, 1964).

A diffusing penetrant of sufficiently light mass (H_2, D_2) dispersed in sufficiently small cavities of certain diffusion systems will possess ground-state quantizations of energy, both in the cavity and in the transition state, which are not negligible. Hence even at or above room temperature small, but sometimes measurable, differences of activation energy are expected to be observed for diffusion and apparent enthalpies of sorption for two isotopic species of the penetrant diffusing in the same medium, providing the mass ratio of the lighter to the heavier isotope is sufficiently small. The change in the apparent enthalpy of sorption is proportional, roughly, to the inverse square of a length available to free motion of the center of mass of the penetrant in the cavity and can thus be used as a measure of the free volume involved in the diffusion. The ratio of the change in diffusion activation energy to the change in the apparent sorption enthalpy yields a length characteristic of the transition state. Gas transmission of H_2, D_2, and He through synthetic natural rubber and polyethylene films was studied from 30 to 60°C. Statistically significant differences in temperature coefficients of permeation, sorption, and diffusion were obtained in these membranes on going from H_2 to D_2. The implications of these observations are developed. (auth)

19962 MOLECULAR REORIENTATION IN LIQUIDS. DEUTERON QUADRUPOLE RELAXATION IN LIQUID DEUTERIUM OXIDE AND PERDEUTEROBENZENE. D. E. Woessner (Socony Mobil Oil Co., Inc., Dallas). J. Chem. Phys., 40: 2341-8(Apr. 15, 1964).

Temperature-dependence measurements were made on the deuteron spin-lattice relaxation times for liquid deuterium oxide and perdeuterobenzene. The quadrupole spin-lattice relaxation is expressed in terms of motional models previously developed for magnetic dipole–dipole relaxation. The deuterium oxide data are discussed in terms of microwave, dielectric relaxation, and hydrogen-bonding phenomena. The T_1 values follow rather closely a proportionality to absolute temperature divided by viscosity. The effective quadrupole coupling constant is only $\frac{2}{3}$ to $\frac{3}{4}$ of the value derived from microwave data. For perdeuterobenzene, the 1.86-kcal/mole activation energy rules out a dominance of the rotational-inertia effect previously proposed. The temperature dependence is much lower than that of the absolute temperature divided by

viscosity. Possible reasons for this are discussed. By use of proton-relaxation data, a quadrupole coupling constant value of 138 kc/sec is estimated, assuming axial symmetry of the electric-field gradient about the C–D bond. (auth)

19963 DIFFUSION OF HYDROGEN, DEUTERIUM, NITROGEN, ARGON, METHANE, AND CARBON TETRAFLUORIDE IN CARBON TETRACHLORIDE. Marvin Ross and Joel H. Hildebrand (Univ. of California, Berkeley). J. Chem. Phys., 40: 2397-9(Apr. 15, 1964).

The diffusion coefficients of gases in CCl_4 were determined by a steady-state method as follows: first figure in each case is for 0°C, the second for 25°C; 10^5 D in cm^2 sec^{-1}: H_2–6.28, 9.75; D_2–•••, 7.80; N_2–2.44, 3.42; Ar–2.44, 3.63; CH_4–2.05, 2.89; CF_4–1.44, 2.04. The product $\sigma^2 D$, where σ is the molecular diameter, is a constant within the limits of accuracy of the data, including the self-diffusion of CCl_4, except in the cases of H_2 and D_2, where it is considerably larger. (auth)

19964 THE ISOTOPIC EXCHANGE BETWEEN o-IODOANISOLE AND INORGANIC IODINE. M. Anbar and R. Rein (Weizmann Inst. of Science, Rehovoth, Israel). J. Chem. Soc.: 975-81(Mar. 1964).

The isotopic exchange between o-iodoanisole and inorganic iodine was investigated in different solvents and at temperatures in the range 79–136°C. The reaction follows a rate law, $R = k[PhI]$ ($k = 20 \times e^{-15.700/RT}$ sec^{-1}, in solvents of moderate polarity), which implies that only the iodo-aromatic compound is involved in the rate-determining step. The rates of spontaneous deiodination, as well as deiodination in the presence of nucleophiles and electrophiles, are much slower than the rate of isotopic exchange. Chloride, butoxide, and stannous ions inhibit the exchange process. It is suggested that the reactive species in the exchange process are elementary iodine and an excited form of the iodo-aromatic compound that is produced in the rate-determining step. (auth)

19965 THE EXCHANGE OF OXYGEN-18 BETWEEN WATER AND PHOSPHOROUS ACID. David Samuel and Brian L. Silver (Weizman Inst. of Science, Rehovoth, Israel). J. Chem. Soc.: 1049-54(Mar. 1964).

The rate of isotopic exchange of oxygen between phosphorous acid and water was measured over the range from pH 10 to 9.4N–$HClO_4$. The observed rate of exchange increases continuously with increasing acidity. The rate constants for the exchange between water and the various ionic species present at different pH's were calculated and the mechanisms of the exchange discussed. (auth)

19966 RAPID SCAN VOLTAMMETRY AND CHRONOPOTENTIOMETRIC STUDIES OF IRON IN MOLTEN FLUORIDES. FABRICATION AND USE OF PYROLYTIC GRAPHITE INDICATOR ELECTRODE. D. L. Manning and Gleb Mamantov (Oak Ridge National Lab., Tenn.). J. Electroanal. Chem., 7: 102-8(Feb. 1964).

Voltammetric and chronopotentiometric studies of iron(II) in molten LiF–NaF–KF and LiF–BeF_2 were conducted. The current–voltage curves were recorded by means of a controlled-potential polarograph capable of measuring cell currents up to 5 mA and providing scan-rates from 50 mv/min to 10 v/min. At faster scan-rates (~1 v/min and greater) peak-shaped curves resulted that indicated that the transport process to the electrode was diffusion-controlled. The diffusion coefficient was calculated to be approximately 1×10^{-6} cm^2/sec and $5 \cdot 10^{-6}$ cm^2/sec in molten LiF–NaF–KF and LiF–BeF_2, respectively. The diffusion coefficient of iron(II) in molten LiF–BeF_2, calculated from chronopotentiometric data, was too large. This was later found to be due to an alternate current path within the cell. Pyrolytic graphite electrodes prepared from commercially available plates, when properly oriented and insulated in boron nitride, appear to be well suited for electrochemical measurements in corrosive melts. (auth)

19967 VOLTAMMETRY OF Ce(IV), Mn(VII), Cr(VI), AND V(V) WITH THE PYROLYTIC GRAPHITE ELECTRODE. F. J. Miller and H. E. Zittel (Oak Ridge National Lab., Tenn.). J. Electroanal. Chem., 7: 116-22(Feb. 1964).

Voltammetry of Ce(IV), Cr(VI), and V(V) in either sulfuric acid or sulfuric acid-phosphoric acid medium is feasible with the pyrolytic graphite electrode (P.G.E.). In these media, the usable potential range extends to +1.5 v vs S.C.E. Data taken from repetitive current–voltage curves are reproducible, the relative standard deviation ranges from 4–8%. No intervening treatment of the electrode is required. The Ce(IV)–Ce(III) electrode reaction at the P.G.E. is reversible. Results of the voltammetry of Mn(VII) are not reproducible. (auth)

19968 ISOTOPIC FRACTIONATION OF HYDROGEN BETWEEN WATER AND THE AQUEOUS HYDROGEN ION. Karl Heinzinger and Ralph E. Weston, Jr. (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 744-51 (Apr. 1964). (BNL-7250)

The fractionation of hydrogen isotopes between aqueous solutions of perchloric acid and the vapor phase in equilibrium with the solutions was measured at 13.5°C. With the usual assumption that the proton is solvated in the form H_3O^+, the separation factor thus obtained can be used to calculate the equilibrium constant, K_L, for the isotope exchange equilibrium, $H_2O + H_2DO^+ = HDO + H_3O^+$. The determined value of 0.96 ± 0.02 is in good agreement with values obtained by other, generally indirect, methods. It is shown that the results are consistent with those obtained by other types of measurement only if the proton is formulated as H_3O^+. (auth)

19969 THE THERMODYNAMIC AND PHYSICAL PROPERTIES OF BERYLLIUM COMPOUNDS. V. HEAT OF FORMATION AND ENTROPY OF BERYLLIUM(I) CHLORIDE(g). Michael A. Greenbaum, M. Louis Arin, Madeline Wong, and Milton Farber (Rocket Power, Inc., Pasadena, Calif.). J. Phys. Chem., 68: 791-5(Apr. 1964).

The equilibrium $BeCl_2(g) + Be(l) = 2BeCl(g)$ was studied over the temperature range 1573-1723°K by the molecular flow effusion technique in order to obtain the heat of formation and entropy for BeCl(g). Over this temperature range ΔH_r was found to be 89.1 ± 7.6 kcal/mole and ΔS_r was 39.4 ± 4.6 cal/deg/mole. From recent experimental data and available thermal functions, the second law $\Delta H_{f,298}$ for BeCl(g) was +3.7 ± 3.8 kcal/mole which compared favorably with the corresponding third law value of +2.0 ± 0.8 kcal/mole. The experimental value for S^0_{298} for BeCl(g) was found to be 53.0 ± 2.3 cal/deg/mole. (auth)

19970 THE FREE ENERGIES OF FORMATION OF THE VANADIUM, NIOBIUM, AND TANTALUM CARBIDES. Wayne L. Worrell and John Chipman (Massachusetts Inst. of Tech., Cambridge). J. Phys. Chem., 68: 860-6(Apr. 1964).

By measuring the pressure of carbon monoxide in equilibrium with graphite–carbide oxide mixtures at temperatures of 1180 to 1370°K, the free energies of formation of the carbon-rich carbides $V\overline{C}$, $Nb\overline{C}$, and $Ta\overline{C}$ were determined. The notations $M\overline{C}$ and $\overline{M}C$ are introduced to denote

carbide compositions, respectively, at the carbon-rich and at the metal-rich boundaries of the homogeneous field. The thermodynamic properties of other group VA carbides ($\overline{M}C$ and M_2C) are estimated from the $M\overline{C}$ data and the phase diagrams. (auth)

19971 SURFACE AREA MEASUREMENT OF GRAPHITE USING THE γ-RADIATION OF Kr^{85}. John T. Clarke (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 884-8(Apr. 1964). (BNL-7566)

A method was developed to measure the surface area of small samples of low surface area materials using the γ radiation of ^{85}Kr-traced Kr to determine the amount of Kr adsorbed. Since the count rate observed is directly proportional to the Kr adsorbed, the method is much more rapid and the calculations much less time-consuming than other methods of surface area measurement. The method is applicable over a wide range of surface areas (0.001 to 10 m^2/g) and to sample sizes of 0.5 g or less. The long half life of ^{85}Kr (10.5 years) minimizes the corrections necessary for radioactive decay. The usual advantages of Kr over nitrogen (inertness, low vapor phase corrections, and spherical shape) are utilized in this method. Using this new method, it was found that the surface area of TSX nuclear graphite increased by a factor of four as the particle size was reduced from 3-mm cubes to 80-mesh. This is interpreted as indicating that the increased surface area results primarily from the opening of closed pores; this allows the surface area of graphite samples having different sizes and shapes to be estimated. (auth)

19972 SELF-EXCHANGE MEASUREMENTS IN A CHELATING ION-EXCHANGE RESIN. A. Schwarz, J. A. Marinsky, and K. S. Spiegler (State Univ. of New York, Buffalo). J. Phys. Chem., 68: 918-24(Apr. 1964).

Self-exchange measurements using ^{22}Na, ^{60}Co, and ^{65}Zn were made with Dowex A-1 chelating resin, a polystyrene–divinylbenzene copolymer containing the iminodiacetic acid functional group attached to the hydrocarbon matrix. The experimental results indicate that a particle diffusion mechanism is the rate-controlling step in the self-exchange process. (auth)

19973 THE FREE ENERGY OF FORMATION OF NIOBIUM DIOXIDE BETWEEN 1100 AND 1700°K. Wayne L. Worrell (Univ. of California, Berkeley). J. Phys. Chem., 68: 952-3(Apr. 1964).

The free energy of formation of NbO_2 was determined by measuring the carbon monoxide equilibrium pressure of the reaction $Nb_2O_5(s) + C\ (gr) \rightleftharpoons 2NbO_2(s) + CO(g)$f between 1050 and 1200°K. Data are tabulated. (P.C.H.)

19974 ESTIMATION OF THE ENTROPY OF FORMATION AT 298°K FOR SOME REFRACTORY METAL CARBIDES. Wayne L. Worrell (Univ. of California, Berkeley). J. Phys. Chem., 68: 954-5(Apr. 1964).

Recent melting point data for the Ti, V, and Cr group metal-carbide systems were used to calculate t_M/t_C values, where t_M and t_C are the melting points of the metal and the carbide, respectively. The melting points, calculated t_M/t_C values, and the available entropy data for the metal carbide systems are tabulated. (P.C.H.)

19975 ASSOCIATION OF SILVER(I) AND CHLORIDE IN MOLTEN CESIUM NITRATE AND IN MOLTEN MIXTURES OF POTASSIUM NITRATE WITH CESIUM NITRATE OR LITHIUM NITRATE. C. Thomas and J. Braunstein (Univ. of Maine, Orono). J. Phys. Chem., 68: 957-9(Apr. 1964).

Measurements were made of association constants of Ag(I) with chloride in molten $CsNO_3$, in molten 67-33 mole % KNO_3-CsNO_3, and in molten 67-33 mole % KNO_3-LiNO_3. It is shown that the results in $CsNO_3$ are consistent with the reciprocal coulomb effect while the solvent effect of lithium ion is anomalous if a single effective radius of nitrate ion is used for all the alkali nitrate solvents. Data are tabulated. (P.C.H.)

19976 CONDUCTANCE OF THE ALKALI HALIDES. VIII. LITHIUM-7 CHLORIDE IN DIOXANE–WATER MIXTURES AT 25°. Thomas L. Fabry and Raymond M. Fuoss (Yale Univ., New Haven). J. Phys. Chem., 68: 971-4(Apr. 1964).

The conductance of ^7LiCl in dioxane–water mixtures was measured in the dielectric constant range $12.95 \leq D \leq 62.43$ at 25 ± 0.002°C. The results suggest that the water structure persists in the mixtures up to about 30 wt % dioxane and that beyond this, the mixed solvent behaves as ordinary liquid. Data are tabulated. (P.C.H.)

19977 THE STANDARD MOLAR FREE ENERGY OF FORMATION OF THORIUM CARBIDE BY ELECTROMOTIVE FORCE MEASUREMENTS. J. J. Egan (Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 978-9 (Apr. 1964). (BNL-7530)

A solid-state galvanic cell in the temperature range 700 to 970°C was used to measure the free energy of formation of ThC_2. At 800°C the standard molar free energy of formation of ThC_2 is −29.4 ± 0.3 kcal/mole. The entropy and heat of formation of ThC_2 were estimated from the results to be −7.2 eu and −37.1 kcal/mole, respectively in the temperature range of the experiments. (P.C.H.)

19978 FIRST OBSERVATION OF A SOLUTION OF Li_3Bi, AN INTERMETALLIC IN MOLTEN LITHIUM CHLORIDE AND LITHIUM CHLORIDE–LITHIUM FLUORIDE. M. S. Foster, C. E. Crouthamel, D. M. Guren, and R. L. McBeth (Argonne National Lab., Ill.). J. Phys. Chem., 68: 980-1(Apr. 1964).

Evidence was obtained for the existence of an intermetallic species (Li_3Bi) in LiCl–LiF. The fused salt electrolyte, which had been maintained under a helium atmosphere, became intensely red in color. Analysis of the electrolyte revealed that both bismuth and lithium were present. Solubility and spectrophotometric measurements were undertaken to gain a better understanding of the nature of the molten salt solution. The solubilities of high-purity, activated Bi in LiCl–LiF eutectic were measured at 600, 700, 800, and 900°C and were found to be 0.9×10^{-3}, 1.6×10^{-3}, 2.0×10^{-3}, and 1.8×10^{-3} wt %, respectively. The spectrum of the red solution at 525°C in the range 5000–30,000 cm^{-1} is characterized by an intense absorption band whose long wave length edge is located at 2.0 ev (16,300 cm^{-1}). (P.C.H.)

19979 NUCLEAR MAGNETIC RESONANCES OF Fe^{57} IN Fe_4N AND Mn^{55} IN Mn_4N. Kiichi Amaya, Yoshitami Ajiro, Hiroshi Yasuoka, Hisashi Abe, Motohiro Matsuura, and Akira Hirai (Kyoto Univ.). J. Phys. Soc. Japan, 19: 413(Mar. 1964).

NMR lines of ^{57}Fe in Fe_4N and ^{55}Mn in Mn_4N were observed at liquid-air temperatures. The resonance lines of the corner site were narrow and strong, being detectable by the steady-state method. The lines of the face-centered site were wide and weak and could be detected only by the pulsed NMR method. (C.E.S.)

19980 NUCLEAR MAGNETIC RESONANCE IN ScN AND VN. Kiyoshi Kume (Tokyo Univ.) and Haruo Yamagishi. J. Phys. Soc. Japan, 19: 414-15(Mar. 1964).

The results of NMR studies of ^{45}Sc in SCN and ^{51}V in VN are reported. The temperature dependence of the Knight

shift and the relaxation times of the metal nuclei were investigated. (C.E.S.)

19981 CHEMICAL INTERACTION OF OXIDES WITH METALS AT HIGH TEMPERATURES. W. J. Kramers and J. R. Smith (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nature, 201: 39-41(Apr. 4, 1964).

Studies were made on the chemical reactions between highly refractory oxides and metals in the temperature range 1000-1600°C to determine the conditions necessary for controlling the amount, distribution, activity, and other properties of different forms of hydrogen bonding. The complex combinations investigated include: Ce, Al; Mn, Ni, Fe; O, N, H; and Ti Mg; Nb Bi, Mo, Sn; O C H, together with additions and impurities including Si S Cl and V Cr Sb. The role of nonmetals such as N, S, Cl, and C, and particular combinations of these, is to modify the structural and exchange characteristics. In addition, silicon influences the hydrogen behavior and in conjunction with other metals and non-metals may take part in a chemical grouping designed to control region or domains of hydrogen behavior in the solid. One important example of a structural deviation occurring in simpler compounds was found in cerium hydrogen oxysulfide. A change in the form of the hydrogen bonding is suggested that does not occur in the Se, though the same result was obtained with the corresponding deuterium compound; Nd behaves similarly. With Y, a similar change was only found in the selenide. (P.C.H.)

19982 INFRA-RED SPECTRA OF DEUTERATED GELATIN SOLS. Robert Austin Milch (Johns Hopkins Univ., Baltimore). Nature, 201: 84-5(Apr. 4, 1964).

Studies were made to determine whether or not the infrared spectra of deuterated gelatin sols could be obtained, especially during the course of genatin sol-gel transition. Significant spectral changes during the sol-gel transition were obviously detectable primarily in the region above 3000 cm^{-1}. Concomitant changes also occurred at about 1550 cm^{-1} and in the amide I band (deuterium-bonded carbonyl C–O stretching vibration at about 1625 cm^{-1}), amide II band (in-plane N–D bending mode + C=N stretching mode of the peptide group at about 1445 cm^{-1}). Only slight increase in intensity was observed in the band about 1330 cm^{-1} in consequence of the temperature effect. The spectral data are thus in accord with the long postulated hypothesis concerning the reversible formation of a systematic set of hydrogen bonds along and between the crystalline portions of gelatin polypeptide chains during the temperature-dependent mutarotation processes of the gelatin sol-gel transition. (P.C.H.)

19983 STUDIES ON THE BEHAVIOR OF SEVERAL ELEMENTS IN THE FUSED BISMUTH–FUSED SALTS SYSTEM. II. ON THE BEHAVIOR OF COPPER IN THE FUSED BISMUTH—FUSED LiCl–KCl (EUTECTIC) SYSTEM. Shigeru Yamagishi and Yuichiro Kamemoto (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 158-64(Mar. 1964). (In Japanese)

The chemical state and distribution coefficient of copper in the fused bismuth—fused LiCl–KCl system were investigated at 550°C in argon or air atmosphere with and without oxidant and reductant. In argon atmosphere, a compound of monovalent copper was more stable than a compound of divalent copper in the fused LiCl–KCl. Then, the cupric chloride added to the fused LiCl–KCl was converted to a colorless compound of monovalent copper with lapse of time. On the other hand, a compound of divalent copper was stable in air atmosphere. The distribution coefficient of copper between fused bismuth and fused LiCl–KCl was 3 and 1×10^2 in argon and air atmosphere, respectively, at 550°C. It was found that the distribution of copper between fused bismuth and fused LiCl–KCl was influenced in argon atmosphere by the presence of reductant or oxidant. Using a bismuth-magnesium alloy (0.2% Mg) in place of bismuth, little copper was extracted from the alloy into the fused LiCl–KCl and the distribution coefficient of copper was made 2×10^{-3}. When excess bismuth chloride was added to the fused LiCl–KCl as an oxidant, copper was almost completely extracted from the fused bismuth into the fused LiCl–KCl and oxidized to a divalent compound. After the added bismuth chloride was used up for the oxidation of Cu, the Cu extracted in the fused salt was converted to the monovalent state and transferred back into the fused Bi until an equilibrium was established. (auth)

19984 STUDIES ON THE REACTION OF URANIUM WITH GRAPHITE AT HIGH TEMPERATURES. Sakae Takeuchi, Toshio Honma, and Tsuneo Satow (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 28: 11-15(Jan. 1964). (In Japanese).

The reaction of uranium metal with graphite was studied in the temperature range of 800 ~ 1100°C. It was found that the reaction rate was parabolic and the activation energy for the reaction was 59 kcal/mole. Marker experiments showed that the growth of carbide film was caused mainly by the migration of carbon. From the results, the rate determining process of the reaction seems to be the diffusion of carbon across the carbide film formed on the metal surface. Hydrocarbon, yielded by hydrolysis of the carbide film, was analyzed by gas-chromatographic method, from which results it was confirmed that the film formed in this temperature range was composed of UC only. X-ray diffraction patterns of the carbide films did not show the existence of U_2C_3 and UC_2. From the parabolic rate constants, self-diffusion coefficients of carbon in UC were calculated. The results were extrapolated and found to agree well with the current results obtained by tracer technique. (auth)

19985 REACTIONS OF BERYLLIUM IN OXIDIZING ENVIRONMENTS. Paul E. Snyder and David J. Boes (Westinghouse Research Labs., Pittsburgh). Nucl. Sci. Eng., 19: 8-17(May 1964).

To evaluate the potential health hazard of beryllium under certain circumstances, a study was made of the interaction of metallic beryllium with oxidizing environments. This study consisted of two parts. Beryllium was subjected to the action of hydrocarbon/hydrogen/oxygen flames at temperatures below and above the melting point. A determination was made of the amount of contamination by the oxide of the downstream flue gases. The experiments indicated that the oxidation rates and the contamination are relatively low below the melting point of beryllium (1283°C). Above this temperature, however, it was found that the molten metal burned rapidly when unprotected by an oxide layer. This caused a sharp increase in both rate of oxidation and in downstream contamination. The behavior of beryllium when surrounded by water substance was investigated. The experimental work was divided into two phases involving reaction in liquid water and in steam. In general, it was found that the oxide layer formed was at first tightly adherent and later became thick and porous. The time between these two conditions depended on temperature, decreasing sharply as the melting point was approached. Upon melting, the oxide layer tended to act as a crucible containing the liquid metal. Under suitable con-

ditions, the liquid would break out of its cage and oxidize very rapidly. When this occurred, the surrounding steam was slightly contaminated with the oxide. (auth)

19986 THE OPTICAL ENERGY GAP OF SCANDIUM OXIDE. A. L. Companion (Illinois Inst. of Tech., Chicago). Phys. Chem. Solids, 25: 357-8(Mar. 1964).

An estimate of the optical energy gap of Sc_2O_3 is reported. Results in the 3.0 to 6.5 ev range are illustrated. The optical energy gap, evaluated at the onset of absorption, is approximately 5.4 ev, a result compatible with the trend shown in similar measurements for neighboring higher metal oxides. (P.C.H.)

19987 THERMAL EXPANSION AND ATOMIC VIBRATION AMPLITUDES FOR TiC, TiN, ZrC, ZrN, AND PURE TUNGSTEN. C. R. Houska (Union Carbide Research Inst., Tarrytown, N. Y.). Phys. Chem. Solids, 25: 359-66(Apr. 1964).

Pure tungsten and nearly stoichiometric ZrC, ZrN, TiC, and TiN were investigated by x-ray diffraction. Thermal expansions and atomic vibration amplitudes were measured, in some cases to above 2000°C. Although a different amplitude is possible for each atom type, a common isotropic amplitude is sufficient to fit the high temperature data, suggesting that equivalent forces act upon each atom within a given material. The vibration amplitude generally increased with thermal expansion, as expected. Compounds containing nitrogen and titanium exhibit larger amplitudes than those containing zirconium and carbon. Among the substances studied, tungsten has the smallest amplitudes and thermal expansions. Debye temperatures derived from the x-ray amplitudes decrease slightly with increasing specimen temperature. (auth)

19988 THE MAGNETIC BEHAVIOR OF GADOLINIUM TRICHLORIDE HEXAHYDRATE AT LOW TEMPERATURES. Peter M. Levy (Laboratoire d'Electrostatique et de Physique du Metal, Grenoble, France). Phys. Chem. Solids, 25: 431-5(Apr. 1964).

From the susceptibility data on $GdCl_3 \cdot 6H_2O$, the crystalline field about the Gd^{3+} ions is inferred to be described by the potential (between T = 2 and 20°K) $V = -0.06[S_x^2 - 1/3S(S+1)] + 0.02(S_y^2 - S_z^2)$ cm^{-1}. This field produces an overall splitting of about 1 cm^{-1} in the ground state $^8S_{7/2}$, and is consistent with the analysis made at the Néel point. The exchange interaction and dipole–dipole coupling give only subordinate contributions to the susceptibility and specific heat. (auth)

19989 VISCOSITY OF THE ISOTOPES OF HYDROGEN AND THEIR INTERMOLECULAR FORCE POTENTIALS. J. Kestin and A. Nagashima (Brown Univ., Providence). Phys. Fluids, 7: 730-4(May 1964).

Measured values of the viscosity are presented for the three isotopes of hydrogen: H_2, HD, and D_2 at 20 and at 30°C, all under atmospheric pressure. The ratios of the viscosity of any one pair of the above gases is obtained very accurately, the major source of error being connected with the uncertainties in the knowledge of the impurities present in the gases. On the basis of the Chapman-Enskog theory for the viscosity of gases composed of spherically-symmetrical molecules whose potentials can be represented by the product $V(r) = \epsilon f(\sigma/r)$, it is concluded that all three isotopes have different intermolecular constants. However, the differences that characterize the intermolecular potentials of H_2 and D_2 are not likely to be large. Calculations which attempt to take into account the differences in the potentials of H_2 and D_2 by differences in polarizability are not confirmed by the present measurements. (auth)

19990 MILLIMETER-WAVE MOLECULAR-BEAM SPECTROSCOPY: ALKALI CHLORIDES. Paul L. Clouser and Walter Gordy (Duke Univ., Durham, N. C.). Phys. Rev., 134: A863-70(May 18, 1964).

The pure rotational spectra of the alkali chlorides were investigated in the 0.96- to 3-mm range of the microwave region with the molecular-beam spectrometer earlier developed at Duke University. Introduction of Teflon microwave lenses and high-pass microwave filters improved this spectrometer so that measurements into the submillimeter region were possible, to an accuracy of better than one part in 10^6. Dunham's solution for the diatomic molecule was applied in interpretation of data. Improved values for B_e, α_e, and γ_e were obtained for most molecules studied. The centrifugal distortion constants D_e and β_e were obtained from the rotational spectra for the first time for all molecules measured. From the latter accurate values of ω_e and $\omega_e\chi_e$ were derived. Other derived quantities are: potential coefficients, isotopic mass ratios, moments of inertia, and internuclear distances. For most of these quantities, the accuracies obtained surpass those from previous measurements. (auth)

19991 MOTIONAL NARROWING OF NUCLEAR MAGNETIC-RESONANCE LINES IN MANGANESE-DOPED LITHIUM FLUORIDE. T. G. Stoebe, T. O. Ogurtani, and R. A. Huggins (Stanford Univ., Calif.). Phys. Rev., 134: A963-4(May 18, 1964).

Nuclear-magnetic-resonance experiments were performed between 25 and 550°C in LiF powder doped with manganese. Motional narrowing of the ^{7}Li resonance line occurred somewhat below 400°C. Resonance absorption lines were not observable in the temperature range 200–390°C, probably because an effective loss of paramagnetic relaxation centers increased the spin-lattice relaxation time. Electron spin-resonance experiments verified that the paramagnetic manganese does cluster upon heating above 200°C. A method of analysis which eliminates errors due to constant linewidth contributions in the analysis of motional narrowing data in terms of diffusion activation energies is developed. The activation energy for motion of Li ion vacancies in LiF is found to be 0.74 ev. (auth)

19992 LATTICE DYNAMICS AND PHASE TRANSITIONS OF STRONTIUM TITANATE. R. A. Cowley (Cambridge Univ., Eng.). Phys. Rev., 134: A981-97(May 18, 1964).

The crystal dynamics of strontium titanate was studied both experimentally and theoretically. The frequency versus wave-vector dispersion curves for some of the normal modes propagating along the [0,0,1] direction were measured by neutron spectrometry at 90 and 296°K. The experiments were performed at the Chalk River Laboratories of Atomic Energy of Canada Ltd., using a triple-axis crystal spectrometer. The temperature dependence of the transverse optic mode of the lowest frequency was found to be in agreement with the temperature dependence of the dielectric constant, as predicted by Cochran. The experimental results were used to obtain the parameters of several models, more than one of which gives reasonable agreement with the experimental results. It is suggested that the anomalous behavior of the elastic properties and the phase transition at 100°K are associated with an accidental degeneracy of two branches of the dispersion curves: the longitudinal acoustic branch and the transverse optic branch of lowest frequency. The origin of the temperature dependence of this transverse optic mode and the relevance of lattice dynamics to the phase transitions in other perovskites are discussed. (auth)

19993 INTERPRETATION OF EXPERIMENTS ON DISSOCIATIVE ATTACHMENT OR IONIZATION OF MOLECULES. P. J. Chantry and G. J. Schulz (Westinghouse Electric Corp., Pittsburgh). Phys. Rev. Letters, 12: 449-52(Apr. 20, 1964).

An error, due to neglecting the target thermal energy, in the usual method of deducing electron affinities from measured ion energies in dissociative reactions is pointed out. In particular, the discrepancy between values of oxygen electron affinity obtained by photodetachment studies and electron impact methods is explained. (M.J.T.)

19994 APPARATUS FOR OBSERVING NUCLEAR QUADRUPOLE RESONANCE (REVIEW). V. S. Grechishkin and G. B. Soifer (Permian State Univ., USSR). Pribory i Tekhn. Eksperim., No. 1, 5-22(Jan.-Feb. 1964). (In Russian)

A review is given of the apparatus for detecting nuclear quadrupole resonance (NQR). The effect of the apparatus parameters on signal reproduction, stationary methods for detecting NQR, impulse methods for detecting NQR, and apparatus for observing the Zeeman effect in monocrystals are discussed. Circuit diagrams are illustrated, and 93 references are cited. (C.E.S.)

19995 SUPPRESSION OF NOISE FOR OBSERVING NUCLEAR MAGNETIC RESONANCE SIGNALS IN A MAGNETIC FIELD. G. S. Anufriev, O. F. Afonin, and B. A. Mamyrin (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 121-3(Jan.-Feb. 1964). (In Russian)

The parameters of a system for a stroboscopic converter for NMR signals in a magnetic field are presented. The system improves the signal-to-noise ratio by factors of 5 to 50. (tr-auth)

19996 A RAPID METHOD OF OBTAINING CERIUM PREPARATION OF VERY HIGH PURITY. Boguslaw Borkowski, Aleksandra Borkowska, and Krystyna Banczykowna. Przemysl Chem., 43: 16-19(Jan. 1964). (In Polish)

The preparation $(NH_4)_2Ce(NO_3)_6$, obtained from technical cerium hydroxide, was used as a material in the method described. The salt was dissolved in water and after some time the solution was poured through a cation exchanger column; the main part of cerium was not detained by the ion exchanger, the cations however, which were the contaminations of ammonium hexanitrate cerate used, were completely removed from the solution. It was also observed that for good yield of pure CeO_2 preparation an interval of time (12-15 hours) between the dissolving of the preparation and the pouring of the solution through the column is indispensable. The influence of aging time of solution, its concentration, and addition of other substances (NH_4NO_3 or HNO_3) on the yield of the method was examined. Under optimum conditions the yield was up to 90% of the theoretical value, and no presence of foreign cations could be established by normal methods of special analysis. Interpretation of the mechanism of the process consists in explaining these phenomena by formation of non-cationic hydronitrate complexes of cerium. (auth)

19997 THE CHEMISTRY OF THE NOBLE GASES. Henry Selig, John G. Malm, and Howard H. Claassen. Sci. Am., 210: No. 5, 66-77(May 1964).

The history and chemistry of the rare gases and their compounds are discussed. Theoretical aspects of rare gas chemistry are also considered. (P.C.H.)

19998 MÖSSBAUER EFFECT IN CHEMISTRY AND SOLID-STATE PHYSICS. Gunther K. Wertheim (Bell Telephone Labs., Murray Hill, N. J.). Science, 144: 253-9(Apr. 17, 1964).

The use of Mössbauer effect in chemistry and solid-state physics is reviewed. Detection of recoil-free gamma rays, atomic motion, the isomer shift, electric hyperfine splitting, and magnetic hyperfine splitting are discussed. 60 references are included. (P.C.H.)

19999 XENON HEXAFLUORIDE COMPLEXES. Henry Selig (Argonne National Lab., Ill.). Science, 144: 537 (May 1, 1964).

Xenon hexafluoride reacts with BF_3 and AsF_5 to form 1:1 adducts, which are white solids with vapor pressures of less than 1 millimeter at room temperature. The $XeF_6 \cdot BF_3$ adduct melts at 90°C to a pale yellow viscous liquid. (auth)

20000 ELECTROLYTIC DISSOLUTION IN A POTENTIAL GRADIENT. S. Hartland and A. J. M. Spencer (Univ. of Nottingham, Eng.). Trans. Inst. Chem. Engrs. (London), 41: 328-35(Dec. 1963).

Electrolytic dissolution in a potential gradient is a possible process for the dissolution of nuclear fuels that possess a number of advantages over other methods. Therefore it was of interest to determine the current through a metal body immersed in an electrolyte to which a potential gradient is applied. For some metal/electrolyte systems it is a good approximation to assume that in the range of interest the anodic and cathodic overpotentials are independent of the current density through the surface of the metal. With this assumption a solution was obtained for the dissolution of a single infinite cylinder in a potential gradient normal to its axis. Expressions were derived for the distribution of current density over the surface of the cylinder and current flow through the cylinder in terms of the overpotentials and the applied potential gradient. (auth)

20001 PREPARATION OF MOLYBDENUM TRISULFIDE FROM INDUSTRIAL FERROMOLYBDENUM DUST. R. A. Pavlyuk, L. M. Kabanova, and Yu. V. Bazhkov. Tsvetn. Metal., No. 2, 51-4(Feb. 1964). (In Russian)

Hydrometallurgical treatment of Mo dust resulting in molybdenum trisulfide was studied with dust containing 11.3% Mo, 4.44% Bi, 18.4% Pb, 20% Zn, 0.33% Cu, 4.88% Fe, 0.58% S, and 13.0% SiO_2. The best results were achieved by leaching with sodium sulfide. In high sodium sulfide concentration (86.4 g/l) the extraction of Mo reaches 86.0%. Precipitation of molybdenum trisulfide as a function of the pH of the solution was studied. It was found that the most complete Mo precipitation was achieved at a pH of 3.0 to 1.5. (R.V.J.)

20002 ISOTOPIC SHIFT IN THE ZIRCONIUM-I SPECTRA. K. Heilig, K. Schmitz, and A. Steudel (Universität, Heidelberg and Technische Hochschule, Hanover). Z. Physik, 176: 120-5(1963). (In German)

Using highly enriched samples of the zirconium isotopes 90, 92, 94, and 96 the isotope shift in the Zr-I spectrum was measured with the aid of a photoelectrically recording Fabry-Perot spectrometer. Both mass-dependent and nuclear-volume effects were found to contribute to the observed shifts. The nuclear-volume dependent part of the measured shifts was determined; the relative position of the isotopes caused by this part is $\Delta\nu_V(90-92):\Delta\nu_V(92-94):\Delta\nu_V(94-96) = 1:(0.70 \pm 0.08):(0.54 \pm 0.06)$. The experimental isotope-shift constants βC_{exp} are (90−92): 44.1 ± 5.1; (92−94): 30.9 ± 5.4; (94−96): 23.8 ± 5.0 mK. (auth)

20003 NUCLEAR RESONANCE ABSORPTION AND LUMINESCENCE CHARACTERISTICS OF ^{57}Fe IN ZnS PHOSPHORS. K. Luchner and J. Dietl (Technische Hochschule, Munich). Z. Physik, 176: 261-76(1963). (In German)

The nuclear resonance absorption spectra of the 14.4-kev gamma line of ^{57}Fe, which were imbedded in different ZnS phosphors, were investigated. It was found that iron as a trivalent ion was incorporated at two different lattice places. At temperatures up to 600°C the incorporation took place predominantly at a regular lattice position; after a heating to 900°C, however, the iron was found chiefly at a lattice position on which an electric field gradient acts, as was seen from the quadrupole splitting that appeared. Both these incorporation states could be assigned two known luminescence characteristics: the red luminescence (after heating to 600°C) and the luminescence quenching action (after heating to 900°C) of the iron. For explanation of the quenching effect a model was proposed: a Fe^{3+} ion finds itself at a Zn^{2+} position in the region nearest a light center. On the basis of the influence of lattice polarization in the region of a disturbance this configuration can form only at higher temperatures, which corresponds to the findings. This model was further supported by the order of size of the electric field gradient and by luminescence measurements, which showed that the band width depends on the amount of iron incorporated at 900°C. The radiation-free transition in this center can take place by the double Franck-Condon process, since it occurs in the light center during the excitation of bound defect electrons to immediate recombination with an available conduction electron from Fe^{3+}. (tr-auth)

20004 ON VALENCY OF RHENIUM IN ITS ORANGE-RED THIOCYANATE COMPLEX. N. Iordanov and M. Pavlova (Inst. of General and Inorganic Chemistry, Sofia). Zh. Analit. Khim., 19: 221-3(1964). (In Russian)

It was established that pentavalent and tetravalent rhenium forms differently colored thiocyanate complexes. (auth)

20005 ON VALENCY OF RHENIUM DURING ITS REDUCTION. Yan Toul, N. G. Ignateva, and V. M. Peshkova (Moscow State Univ.). Zh. Analit. Khim., 19: 224-8 (1964). (In Russian)

The potential jump on the curve of perrhenate electrolytic reduction corresponds to its reduction to Re(IV). The reduction process necessarily goes through the formation of Re(V) compounds; mercury and tungsten indicator electrodes do not show distinctly this valency state of rhenium. On durable reduction (3-4 hrs) perrhenate is reduced to Re(III), which is rapidly oxidized in the air to Re(IV). (auth)

20006 ON VALENCY OF RHENIUM IN ITS THIOCYANATE COMPLEX COMPOUND. D. I. Ryabchikov and I. I. Nazarenko (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Zh. Analit. Khim., 19: 229-31(1964). (In Russian)

It was shown that rhenium(V) forms two complex compounds with thiocyanate ions: a yellow-green one with the maximum absorption at 350 mμ and a red-orange one with the maximum absorption at 420 mμ. Under certain conditions a reversible conversion of one complex into the other is possible. The red-orange rhenium-thiocyanate compound was precipitated by means of Rayse-I salt and analyzed for Re, Pt, and S. It follows from the data obtained that the composition of the complex red-orange rhenium-thiocyanate anion can be expressed by the formula $[ReO_2(SCN)_4]^{3-}$. (auth)

20007 THE MÖSSBAUER EFFECT OF Sn^{119} NUCLEI IN GOLD, PLATINUM AND THALLIUM MATRICES. V. A. Bryukhanov, N. N. Delyagin, and Yu. Kagan (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 825-8(Mar. 1964). (In Russian)

The probability for resonance absorption of 23.8-kev γ quanta without recoil by ^{119}Sn nuclei in gold, platinum, and thallium matrices is measured in a broad temperature range. The measurements are carried out for rigid solutions of tin in gold (1.7 and 3.2 at. % of tin), in platinum (1.5 at. % tin) and in thallium (3.6 and 9.2 at. % tin). The experimental data are compared with the theoretical results previously obtained by Kagan and Iosilevsky. Satisfactory agreement between the experimental and theoretical values for the probability of the effect was obtained throughout the whole temperature range. Within the experimental errors no difference was observed in the effect for alloys of various concentrations. (auth)

20008 TEMPERATURE DEPENDENCE OF ISOTOPIC EFFECTS IN THE STRUCTURAL PROPERTIES OF HYDROGEN ISOTOPES. R. F. Bulatova and V. S. Kogan (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 840-2(Mar. 1964). (In Russian)

X-ray patterns of hydrogen isotope layers condensed on the lateral surface of a copper rod at various temperatures (between 1.3 and 4.2°K) are obtained. The deuterium x-ray patterns do not depend on the temperature and are the same as those of protium condensed below 2.8°K. However patterns of protium obtained by condensation at temperatures above 2.8°K exhibit a larger number of interference lines. The results are discussed from the viewpoint of the texture being dependent on the condensation temperature. (auth)

20009 PREPARATION OF NIOBIUM BY REDUCTION OF $NbCl_5$ BY HYDROGEN. L. A. Niel'son, Ya. M. Polyakov, and A. N. Krestovnikov. Zh. Prikl. Khim., 37: 669-72(Mar. 1964). (In Russian)

The equilibrium constants and the yield of the reaction $(NbCl_5) + 2\frac{1}{2}(H_2) \rightleftharpoons (Nb) + 5(HCl)$ were studied as functions of the temperature and $NbCl_5$ concentration. Purified niobium was precipitated on a 0.2-mm-thick, 5-mm-wide, and 100-mm-long heated niobium band at 820 to 1600°C. It was found that with 0.1 to 0.2 mole $NbCl_5$ and one mole of $NbCl_5-H_2O$ mixture at 1000 to 1300° the rate of niobium precipitation was 0.7 to 1.5 $g/cm^2/hr$ with a yield of 1.5 to 3.2 g Nb per mole of mixture, with 15 to 30% transformation of $NbCl_5$ into metal. (R.V.J.)

20010 MEASUREMENT OF TRANSFERENCE NUMBERS IN ELECTROLYTE SOLUTIONS WITH THE MOVING BOUNDARY METHOD USING RADIOACTIVE ISOTOPES. G. Marx. Thesis, Berlin, Technische Hochschule, 1963. 108p. $2.00(Gmelin, AED-DISS. 63-318). (In German)

Optimal counting arrangements for the measurement of the boundary between an inactive and a radioactive solution are studied. Design and construction of an apparatus for the measurement of boundary location are described. Transference numbers of H^+ and $H_2PO_4^-$ are given. (Gmelin Inst.)

20011 ENERGY AND MASS DEPENDANCE OF THE LUMINESCENCE OF ZnS AFTER EXCITATION WITH IONS. D. Eitner. Thesis, Berlin, Universität, 1963. 47p. $2.00(Gmelin, AED-DISS. 63-286). (In German)

Excitation of luminescence in polycrystalline ZnS by positive ions of various masses and energies is studied. An empirical formula for decrease of luminescence is given. The damage constant is low for H_2^+ ion, has a maximum for medium masses, and decreases for heavy particles. Energy dependence of luminescent yield is studied for ions with 6 different masses for energies between 1 and 40 kv. Results can be explained with the Mott and Masey

cross sections for inelastic scattering of heavy particles. (Gmelin Inst.)

20012 ON SOME NEW URANATES, POLYURANATES AND POLYNEPTUNATES. Sieghard J. Neufeldt. Thesis, Munich, Ludwig-Maximilians-Universität, 1963. 118p. (In German)

By pryolysis of stoichiometric mixtures of metal nitrates and uranyl nitrates, normal uranates of the first and second subgroups were prepared. By heating at 600°C, the compounds $CuUO_4$, $ZnUO_4$, and $CdUO_4$ were prepared in this manner. $HgUO_4$ was obtained in the same way by heating the nitrates at 300, 350, and 400°C. Attempts to prepare Ag_2UO_4 in the same way lead to a preparation, which was highly contaminated with metallic silver. An essentially pure product was obtained, however, by heating a stoichiometric mixture of $AgNO_3$ and UO_2 at 300, 400, and 500°C. Lattice constants and crystal structure were determined for each compound. Attempts to prepare corresponding neptunates in an analogous way were unsuccessful. The preparation of polyuranates was carried out by pyrolysis of uranyl nitrates in a $LiNO_3-KNO_3$ eutectic. Similar tests with neptunyl nitrate in a $LiNO_3-KNO_3$ eutectic gave polyneptunates. (M.C.G.)

20013 CHEMICAL EFFECTS OF D.C. DISCHARGES. F. D. A. Boylett (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). p.317-20 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol II." Paris, SERMA, 1963.

An investigation of the behavior of chemical products, resulting from electrical discharges at atmospheric pressure in uniform and non-uniform electric fields, is described. Different mixtures of nitrogen and water vapor, at constant volume, were used and the shape of the spark-over voltage versus gas composition curves, which were of a hysteresis shape, are explained in terms of the production of oxides of nitrogen by the discharge. Chemical analyses of the gases, both before and after the discharges occurred, supports the explanation. The importance of the results are discussed and compared with the conclusions of others. (auth)

20014 ADSORPTION OF WATER AND CARBON DIOXIDE ON BERYLLIUM OXIDE. W. I. Stuart, L. E. Smythe, G. H. Price, and J. J. Lawrance (Australian Atomic Energy Commission). 21p. (CONF-281-38)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Adsorption of carbon dioxide and water on beryllium oxide was studied by volumetric, thermogravimetric, and infrared spectrophotometric techniques. Some of the main results are described. Water is both physically adsorbed and chemisorbed. Chemisorption leads to formation of hydroxyl groups, which are remarkably stable and can exist at the surface at 800°C or higher temperatures. Some hydroxyl groups are hydrogen bonded, either to neighboring hydroxyl groups or surface oxygen atoms. Below 0°C, carbon dioxide is physically adsorbed. At higher temperatures, however, a slow activated process of chemisorption takes place which leads to formation of $CO_3^=$ or CO_3^- surface ions. (auth)

20015 THE GROWTH AND PROPERTIES OF SINGLE CRYSTALS OF BERYLLIUM OXIDE. J. W. Kelly (Australian Atomic Energy Commission). 19p. (CONF-281-37)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Results are given of work on the growth of single crystals of beryllium oxide by three methods: slow cooling of a saturated flux, growth in a temperature gradient, and growth from a vapor phase, using lead oxide, lead fluoride, or mixtures thereof, as flux. The most promising method for the production of large perfect crystals is growth in a temperature gradient, even though the largest crystals produced to date (≈5 mm) were by the slow-cooling method. The morphology, chemical reactivity, hardness, and mode of growth of the crystals were examined and in each case they were found to be asymmetrical depending not only on the crystallographic direction but on its sense. A consistent explanation of these properties was derived using the model of a polar lattice developed for Group III to V compounds by Gatos and Lavine (J. Electrochem. Soc., 107: 427(1960)). (auth)

20016 THE HIGH TEMPERATURE REACTION BETWEEN BERYLLIA AND WATER VAPOUR. W. I. Stuart and G. H. Price (Australian Atomic Energy Commission). 16p. (CONF-281-39)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Water vapor reacts with beryllium oxide to form a volatile complex. This reaction was studied in the temperature range from 1065 to 1380°C. Steam or moist argon was passed through a static bed of sintered beryllium oxide and weight losses from the bed were measured thermogravimetrically. The measurements referred to equilibrium conditions where steam or moist argon became saturated with the volatile complex. Moles of $BeO(n_{BeO})$ lost from the bed were measured as a function of n_{H_2O}, the moles of water passed. The ratio n_{BeO}/n_{H_2O} at constant temperature was independent of water vapor pressure between 57 and 760 mm Hg. Weight losses of Beo were a function solely of temperature and water throughput, and can be described by the equation: $\log n_{BeO} = 1.62 - 8.8 \times 10^3/T°K + \log n_{H_2O}$. This equation offers a method of estimating maximum annual losses of BeO in a reactor. Some typical estimates are listed. (auth)

20017 NUCLEAR MAGNETIC RESONANCE OF Be^9 IN SINGLE CRYSTALS OF BeO. G. J. Troup and J. Walter (Monash Univ., Victoria, Australia). 7p. (CONF-281-24)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The NMR spectrum of ^{9}Be in BeO single crystals was measured at room temperature and at liquid nitrogen temperature. Results of the measurements are presented and interpreted in the light of the theoretical work of Bolton and Sholl. (auth)

20018 THERMODYNAMIC AND TRANSPORT PROPERTIES OF POTASSIUM. A. W. Lemmon, Jr., H. W. Deem, E. H. Hall, and J. R. Walling (Battelle Memorial Inst., Columbus, Ohio). New York, American Inst. of Chemical Engineers, 1963, Preprint 41b, 26p, $0.50. (CONF-473-1)

From American Institute of Chemical Engineers 56th Annual Meeting, Houston, Oct. 1963.

Reliable values for many of the basic thermodynamic and transport properties of K were measured or derived. The work led to the development of some new experimental techniques, but also pointed out the extreme difficulties that can be encountered when work at such high temperatures is necessary. Data are reported for enthalpy of the solid and liquid K, vapor pressure, P-V-T characteristics, liquid viscosity, and liquid thermal conductivity. Computed results for the specific heats, enthalpy, and entropy are also reported. (P.C.H.)

20019 PARAMAGNETIC RESONANCE SPECTRA OF THE $3d^5$ CONFIGURATION OF CHROMIUM IN ZnSe AND

ZnTe. Reuben S. Title (International Business Machines, Yorktown Heights, N. Y.). 18p. (CONF-481-28)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Paramagnetic resonance measurements were made for the $3d^5$ configuration of Cr^+ in ZnSe and ZnTe. The g factor, the cubic crystalline field parameter α, the hyperfine interaction with ^{53}Cr, $A(^{53}Cr)$ and the hyperfine interaction A_{Zn} with ^{67}Zn nuclei occupying any of the twelve equivalent cation sites nearest the chromium were determined. These resonance parameters are compared with those previously measured for Cr^+ in cubic ZnS and CdTe and the variations from crystal to crystal are found to be consistent with changes in the covalency of the bonds and with lattice distortions caused by incorporating Cr^+ substitutionally for the much smaller divalent zinc. The hyperfine interaction with ^{67}Zn (or ^{111}Cd and ^{113}Cd) at second neighbor sites is, unlike the interaction of the isoelectronic Mn^{2+} with these sites found to vary from crystal to crystal in a manner consistent with changes in the covalent bonding. (auth)

20020 THE CRYSTAL STRUCTURE OF LIME-STABILIZED ZIRCONIA. P. R. Van Loan, L. J. Beaudin, and S. I. Fernandes (Norton Co., Chippawa, Ont.). 6p. (CONF-372-2)

From Annual Pittsburgh Diffraction Conference, Pittsburgh, Nov. 1963.

Crystallographic studies were made on the equilibrium cubic phase in lime-stabilized zirconia, which is $CaZr_4O_9$. The structure determination of calcium tetrazirconate was based upon intensity measurements of a pattern of powdered $CaZr_4O_9$ recorded on a diffractometer. Pycnometric measurements (mean of two determinations) gave a specific gravity value of 5.368. The unit cell content was established as 1 ($Ca_{0.78}Zr_{3.21}O_{7.18}$). Systematic extinctions indicate that the space group is Fm3m (O_h^5) – that of fluorite-type structures. The results established that the pure stoichiometric compound contains 10.21 wt % CaO, with a unit cell content of 1 ($Ca_{0.80}Zr_{3.20}O_{7.20}$), and a lattice parameter a = 5.138 ± 0.001 Å. Theoretical density is 5.375. (P.C.H.)

20021 NEW TECHNIQUE FOR THE STUDY OF ION-ATOM INTERCHANGE. C. H. Bloomfield and J. B. Hasted (Univ. of London). 9p. (CONF-462-5)

From The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

The mean cross-section for an ion-atom interchange process is deduced from an analysis of the two mobility peaks displayed by a mass-analyzed ion-beam injected into a drift tube. The experiment is described and a mean cross-section 0.4×10^{-16} cm^2 at a temperature of 540°K is deduced for the process, $NeAr^+ + Ar \rightarrow Ne + Ar_2^+$; the cross-section falls sharply with increasing temperature. Various findings concerning the mobilities and identification of ions O^+, O_2^+, Ar^+, Ar^{2+}, and Ne^+ in Ar and N_2 are reported. (auth)

Organic Chemistry

20022 (CONF-322-10) STUDIES OF REACTIONS OF ATOMIC CARBON BY A DOUBLE TRACER TECHNIQUE. James Dubrin, Colin MacKay, and Richard Wolfgang (Yale Univ., New Haven and Haverford Coll., Haverford, Penna.). [1963]. Contract [AT(30-1)-2052]. 4p.

From the American Chemical Society, Production Technology of Np-237 and Pu-238, Denver, Jan. 1964.

Results of studies on carbon atom reaction mechanisms using a double tracer technique are reported. Mechanisms of the formation of allene, propylene, and ethylene from C atom reactions with ethylene, and ethane, were studied. It was concluded that allene is produced predominantly by interaction of a carbon atom with a single ethylene molecule. The formation of propylene from ethane has a formal similarity to the formation of allene from ethylene. The mechanism for ethylene production from ethane is consistent with C atom insertion into a C–H bond. (P.C.H.)

20023 (TID-20510) NUCLEAR SPECTROSCOPY AND THE STUDY OF REACTION KINETICS. Final Report. D. C. Conway (Purdue Univ., Lafayette, Ind. and Purdue Research Foundation, Lafayette, Ind.). Apr. 1, 1964. Contract AT(11-1)-694. 98p.

The temperature dependence of the equilibrium constant for the reaction $O_2^+ + O_2 \rightarrow O_4^+$ was determined. The observed entropy change appears to be inconsistent with four degrees of freedom in O_4^+. When the temperature of the system was lowered to liquid N_2 temperature, heavier ions (O_8^+, O_8^+, O_{10}^+, and O_{12}^+) were formed. The beta spectrum of ^{32}Si was also studied. The end-point energy of 100 dpm of ^{32}Si as $Si^*(C_2H_5)_4$ was found to be 213 ± 7 kev using a liquid scintillation spectrometer. The log-ft for the allowed, 1-forbidden transition is 8.2. Further, a Re compound that could be mixed with the gas of a proportional counter so the ^{187}Re beta spectrum could be measured was found. From five measurements at 130 and 140°C, the end-point energy was determined to be 2.64 ± 0.06 kev. The L/K and M/L capture ratios for ^{109}Cd were also sought; the L/K ratio was successfully determined. Additionally, the pyrolysis of tagged ethyl iodide was studied in the presence of the radical scavenger toluene in a flow system. The rates of formation of ethane, ethylene, and bibenzyl were determined as a function of the contact time, toluene pressure, and ethyl iodide pressure at 774°K. (D.C.W.)

20024 SYNTHESIS OF THIOPHOSPHORIC ESTERS LABELED WITH P^{32}. Mario Dubini (Istituto di Ricerche G. Donegani, Novara, Italy). Ann. Chim. (Rome), 53: 1421-6(Oct. 1963). (In Italian)

Ethyl O,O-dimethylmonothiophosphoryl-β-phenylacetate-^{32}P and ethyl O,O-dimethyldithiophosphoryl-β-phenylacetate-^{32}P were synthesized for use in biochemical studies of insecticides. For the preparation of the first compound, dimethyl phosphite was exchanged with $H_3P^{32}O_4$ by the method of Cassida. This was converted to Na O,O-dimethylmonothiophosphate-^{32}P by reaction of the dimethyl phosphite-^{32}P with sodium methoxide and S at 0.5°C. The salt was condensed with ethyl phenylbromoacetate at 70°C to give the desired monothio compound in 46% yield based on dimethyl phosphite-^{32}P; it showed radioactivity concentrated in one zone on thin layer chromatography. For the preparation of the second (dithio) compound, irradiated red P was reacted with S in a special apparatus. Addition of methanol in toluene to this $^{32}P_2S_5$ gave dimethyl-dithiophosphoric acid-^{32}P, which was then converted to its Na salt by neutralization with 3N NaOH. The Na salt solution was reacted at room temperature with an acetone solution of ethyl phenylbromoacetate, producing the desired product, which had only one center of radioactivity on thin layer chromatography, in 54.1% yield based on red P. Ethyl O,O-dimethylmonothiophosphoryl-β-phenylacetate has b.p. 170–180°C (1 mm Hg), n_D^{20} 1.5220; ethyl O,O-dimethyldithiophosphoryl-β-phenylacetate has b.p. 80–100°C (1 mm Hg), n_D^{20} 1.5538. (BBB)

20025 SYNTHESIS OF PALMITALDEHYDE-1,2-^3H. Benjamin Weiss (Columbia Univ., New York). Biochemistry, 3: 584-7(Apr. 1964).

Palmitoin was oxidized to the diketone with CrO_3 in glacial acetic acid. Both the diketone and palmitoin were hydrogenated over Pt in glacial acetic acid in the presence of ^3H_2O. The glycol was degraded with periodic acid to palmitaldehyde-1,2-^3H, and the isotope distribution on carbon atoms 1 and 2 was determined by derivatization to the thiosemicarbazone and by oxidation and conversion to palmitamide. The aldehyde obtained by reduction of the diketone was of higher specific activity than that derived from acyloin, but the C-1/C-2 ratios of tritium activity were similar. Reduction of the diketone with [^3H]$LiAlH_4$ yielded aldehyde with high specific activity and with isotope predominantly on carbon atom 1. (auth)

20026 EXCESS-KINETIC-ENERGY IONS IN ORGANIC MASS SPECTRA. John Olmsted, III, K. Street, Jr., and Amos S. Newton (Univ. of California, Berkeley). J. Chem. Phys., 40: 2114-22(Apr. 15, 1964). (UCRL-10823(Rev.))

The characteristics of excess-kinetic-energy ions in mass spectra were studied with a Dempster-type mass spectrometer. A method was devised whereby the total initial kinetic energies possessed by such ions could be measured more accurately than has been done previously, and the kinetic energies of methyl ions, both near-thermal and excess-kinetic-energy, from a wide variety of different organic compounds, are presented. Appearance potential curves were obtained for several excess-kinetic-energy methyl ions; these show a second-power dependence of cross section on electron energy in the threshold region with threshold values of the order of 30 ev. Finally, a method of estimating the discrimination factor of the mass spectrometer toward ions possessing excess kinetic energy was utilized to obtain values for the actual abundances of excess-kinetic-energy methyl ions in the fragmentations of several organic compounds. Actual abundances of from 2 to 10% of the total ions in the mass spectrum were found from many compounds. The values of appearance potentials, kinetic energies, and abundances that were measured for the complementary excess-kinetic-energy ion pairs from methyl amine (masses 15 and 16) and propane (masses 15 and 27) are consistent with a mechanism for formation in which both ions arise from the same initial state in each respective case. The data support the suggestion that excess-kinetic-energy fragment ions from the organic compounds are formed by breakdown of doubly charged parent ions. (auth)

20027 DEUTERIUM EXCHANGE IN THE PYRIDOXAL-LEUCINE SYSTEM. G. A. Junk and H. J. Svec (Ames Lab., Ames, Iowa). J. Org. Chem., 29: 944-6(Apr. 1964).

Spectral studies on deuterium exchange in the pyridoxal-leucine system are reported. The results confirm that the pyridoxal-metal-amino acid reaction mechanism proceeds through formation of the generally accepted Schiff base intermediate. The α-position protiums are replaced with deuteriums through tautomerization of the Schiff base. The β activation occurs by tautomerization of the Schiff base and/or the α-keto acid. It was concluded that the reaction of amino acids with pyridoxal appears to be generally useful for the selective labeling of amino acids in both the α- and β-positions. (P.C.H.)

20028 THE CHEMISTRY OF POLY(VINYL CHLORIDE) STABILIZATION. III. ORGANOTIN STABILIZERS HAVING RADIOACTIVELY TAGGED ALKYL GROUPS. Alfred H. Frye, Raymond W. Horst, and Marko A. Paliobagis (Cincinnati Milling Machine Co. and Carlisle Chemical Works, New Brunswick, N. J.). J. Polymer Sci., Pt. A, 2: 1765-84 (Apr. 1964).

The stabilizing action of a representative group of organotin compounds of the formula Bu_2SnY_2 was studied by a radioactive tracer technique, the tags (^{14}C) being located in the butyl group's C_1-position. The Y groups of the chosen organotin compounds were: monomethyl maleate, oxoöctyl thioglycolate, β-mercaptopropanoate, and 2-ethylhexanoate. It was found that after a sequence of two dissolution and precipitation cycles (using tetrahydrofuran and methanol) an appreciable portion of radioactivity is retained by the resin, the resins having been previously admixed with the tagged stabilizer, milled into films, and then subjected to carefully controlled heat treatments. Under these conditions it was found that the amount of radioactivity retained by the resin was determined by the nature of the Y group and the duration of the heat treatment. Further, it was found that for a given Y group, the amount of retention first increases with increase in the duration of the heat treatment, reaches a maximum, and then drops off. However, the amount of radioactivity retained by such a resin was not found to be constant when the sample was subjected to further dissolution-precipitation cycles, but, within the limits of the present experiments, to decrease markedly with each successive cycle. It is suggested that the major portion of this retention is due to the formation of an associative link between the polymer and the organotin compound and that this linkage is partially ruptured by the tetrahydrofuran–methanol treatment. It is also shown that only a very minor portion of the radioactivity retained by the precipitated resin can be due to actual butylation of the resin, and that it is unlikely that it could contribute appreciably to the resin's stabilization. It is suggested that the formation of an associative complex between the resin and the organotin compound functions as a precursor wherein certain relatively labile centers in the polymer chain can be altered, possibly by a displacement reaction involving the organotin compound's Y group, and in this way retard or inhibit the zipperlike elimination of hydrogen chloride, which is the initial phase of the polymer's degradation. (auth)

20029 THE CHEMISTRY OF POLY(VINYL CHLORIDE) STABILIZATION. IV. ORGANOTIN STABILIZERS HAVING RADIOACTIVELY TAGGED TIN ATOMS. Alfred H. Frye, Raymond W. Horst, and Marko A. Paliobagis (Cincinnati Milling Machine Co. and Carlisle Chemical Works, New Brunswick, N. J.). J. Polymer Sci., Pt. A, 2: 1785-99 (Apr. 1964).

The chemistry of poly(vinyl chloride) stabilization by organotin compounds was studied by the use of a radioactive tracer technique. The stabilizers studied were of the type $[R_2SnY_2]_n$, where R was either butyl or octyl, Y either monomethyl maleate, oxooctylthioglycolate, or β-mercaptopropanoate, and ^{115}Sn was the radioactive tag. It was found that resins milled into films with the tagged stabilizers retain an appreciable amount of radioactivity after the films were subjected to the conditions of accelerated thermal degradation, dissolution in tetrahydrofuran, and thereafter precipitated from solution by the addition of methanol. The amount of retained radioactivity varies with the duration of the heat treatment and with the nature of the Y group in a manner that parallels previously reported findings using a ^{14}C tag in the stabilizers' butyl groups. It was also found that the amount of radioactivity retained by the precipitated resins decreases in a regular manner when the resins are subjected to a sequence of repeated dissolutions and precipitations. However, in the case of the resin stabilized with dibutyltin-^{113}Sn bis(monomethyl maleate) at least, the loss of radioactivity with repeated dissolution and precipitation appears to level off after 13–14 cycles and approach a constant value of retention. Treatment of the radioactive

resins with anhydrous hydrogen chloride results in the loss of essentially all their radioactivity. On the basis of these findings, it is suggested that in the performance of their stabilizing action, the organotin compounds undergo little or no cleavage of their carbon–tin bonds. Further, the observed retention of radioactivity by the resin is best rationalized as due to the existence of a coordinative linkage formed between the stabilizer's tin atom and some donor atom present in polymer's molecular structure. (auth)

20030 THE CHEMISTRY OF POLY(VINYL CHLORIDE) STABILIZATION. V. ORGANOTIN STABILIZERS HAVING RADIOACTIVELY TAGGED Y GROUPS. Alfred H. Frye, Raymond W. Horst, and Marko A. Paliobagis (Cincinnati Milling Machine Co. and Carlisle Chemical Works, New Brunswick, N. J.). J. Polymer Sci., Pt. A, 2: 1801-14(Apr. 1964).

Experiments with a select group of radioactively tagged organotin stabilizers of the general formula Bu_2SnY_2, in which the radioactive atoms (^{14}C) are located in the Y groups, have shown, that, under the conditions normally employed to evaluate and screen poly(vinyl chloride) heat stabilizers, a portion of that radioactivity becomes firmly associated with the resin. Under standard conditions, the extent of this association was found to be dependent upon the nature of the Y group and the duration of the heat treatment. It is suggested that the stabilizing action of these organotin compounds arises in part from reactions between the polymer and the stabilizer wherein certain of the polymer's chlorine atoms are exchanged for the stabilizer's Y groups (or a portion thereof), the resulting structures being more stable toward degradative elimination. Other possibilities for reaction between the polymer and the stabilizer are also considered and it is shown how these can further supplement the organotin compound's stabilizing action and yet be rationalized within the experimental evidence. (auth)

20031 TRITIUM-LABELED COMPOUNDS. X. ISOTOPE EFFECTS IN THE OXIDATION OF ALDOSES-1-t WITH BROMINE. Horace S. Isbell and Lorna T. Sniegoski. J. Res. Natl. Bur. Std., 68A: 145-51(Mar.-Apr. 1964).

Tritium isotope effects were used in bromine oxidation studies of aldoses to evaluate the reaction paths of direct oxidation and oxidation after anomerization. Because the former path involves a primary isotope effect ($k^*/k = 0.14$, approximately) and the latter a secondary isotope effect ($k^*/k = 0.80$, approximately) it was found possible to evaluate the relative importance of the two reaction paths from the overall isotope effects, which ranged from 0.20 to 0.59. Under the conditions reported, the direct oxidation for the axial anomers ranges from 38% for α-D-galactose to 94% for α-D-lyxose. Differences in the proportion of the anomer oxidized by each of the two paths were explained by variations in the free energy required for reaching the respective transition states. Aldoses of high conformational stability having an axial C1-hydroxyl group resist the change in conformation necessary for direct oxidation and react in large measure through a change in configuration (anomerization). Aldoses of lower conformational stability having an axial C1-hydroxyl group react largely through a change in conformation, because this path does not have a high energy barrier. The equatorial anomers of D-glucose-1-t and maltose-1-t showed isotope effects of 0.32 and 0.23, respectively in comparison with a value of 0.14 previously found for the oxidation of aldoses-1-t with iodine in alkaline solution. The isotope effect in the oxidation of D-glucose-1-t with D-glucose oxidase at 30°C was found to be 0.15. These strong isotope effects are in accord with the rupture of the C1 to H bond in the rate-determining step. The following reactions gave the values for k^*/k cited in parentheses: D-glucose-1-t + NaCN (0.83); D-glucose-1-^{14}C + NaCN (1.00); D-glucose-1-t + $NaBH_4$ (0.73); D-mannose-1-t + phenylhydrazine (0.83); and D-mannose-1-^{14}C + phenylhydrazine (0.95). The values of k^*/k are typical of aldose reactions involving rate-determining isomerization of the pyranose structure. The isotope effects were measured by a double-label method and by a newly developed method based on the radioassay of water evolved in the reaction. (auth)

20032 ON THE SOLID-STATE POLYMERIZATION OF TRIOXANE. M. D'Alagni, P. De Santis, A. M. Liquori, and L. Mazzarella (Università, Naples and Centro Nazionale di Chimica delle Macromolecole (CNR), Naples). Nuovo Cimento (10), 31: 1368-71(Mar. 16, 1964).

The solid-state polymerization of trioxane was studied at 55 and 17°C by suspending pure crystals in n-hexane containing boron trifluoride, a cationic catalyst. X-ray diffraction photographs of the polymers are interpreted. (R.E.U.)

20033 SYNTHESIS OF α-DL-ALANINE-2-C^{14}. M. Bubner and L. H. Schmidt (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Pharmazie, 18: 668-72(Oct. 1963). (In German)

A multistep synthesis of alanine-2-^{14}C in 32 to 47% overall yield based on starting Na acetate-^{14}C is described. High yields are obtained by the use of high vacuum techniques, and the apparatus is illustrated. Na acetate-1-^{14}C is acidified with HCl to yield acetic acid-1-^{14}C in 99% yield. This is converted to acetyl chloride in 97.0% yield by the use of phthaloyl chloride at 80°C. The acetyl chloride-1-^{14}C is reduced with 2N $LiAlH_4$ in diethylene glycol–diethyl ether at 0°C, giving ethanol-1-^{14}C in 88% yield. The alcohol is next converted into ethyl iodide-1-^{14}C with HI at 110–130°C; the yield is 71% based on Na acetate. The ethyl iodide is converted to the Grignard reagent and carbonated to yield (as the isolated product) sodium propionate-2-^{14}C in 81% yield (based on ethyl iodide, or 58% based on Na acetate). The salt is converted into the free acid in the fashion described for acetic acid, and this is treated with red P and Br_2 to yield α-bromopropionic acid-2-^{14}C in 52% yield (based on Na acetate). Treatment of this with ammonium carbonate–aqueous ammonia at temperatures not over 60°C yields α-DL-alanine-2-^{14}C in 79% yield (based on bromoacid; 41% based on Na acetate) after purification on a Wofatit F column and sublimation. No further impurities could be detected by paper chromatography. Alanine labelled in the one or three position may be prepared in an analogous fashion. (BBB)

20034 CRYSTALLINE OLEFIN POLYMERS. PART II. High Polymers. A Series of Monographs on the Chemistry, Physics, and Technology of High Polymeric Substances. Volume XX. R. A. V. Raff and K. W. Doak, eds. New York, Interscience Publishers, 1964. 687p. $22.50.

Information is included on properties of crystalline olefin polymers, which included brittleness, stress-cracking, electrical properties, permeability, and miscellaneous properties and tests, and technology, which includes chemical modification, radiation effects on properties, degradation and stabilization, processing of crystalline olefin polymers, and applications. One article, irradiation-properties changes, was abstracted separately in NSA. A separate patent index is included. (P.C.H.)

For abstract of individual paper see: 20089.

20035 ABSOLUTE X RAY SCATTERING CROSS SECTIONS OF LIQUIDS AND SOLUTIONS. Lawrence Bruce

Shaffer. Thesis, Madison, Wisc., Univ. of Wisconsin, 1964. 116p.

Absolute measurements of the product of the number density of molecules in a sample and the molecular differential x-ray scattering cross section at small angles was accomplished by comparing the small angle x ray scattering observed from the sample with the scattering observed from a standard sample for which the differential scattering cross section and number density are known. Three heavy gases were intercompared and used as primary standards. The scattering from solutions and liquids was observed in the identical geometry as the gas scattering, thus eliminating complicated geometric corrections. Single crystal quartz plates 0.0010 in. thick were used as sample holder windows. The three gases gave a calibration of the incident beam and geometry to ±2%. A scattering 10% in excess of that predicted using thermodynamic relationships was observed for water, ethyl alcohol, xylene, and benzene. Scattering observed from solutions of metmyoglobin was within 3% of the predicted scattering whereas for ribonuclease a 30% excess scattering was observed. The excess is ascribed to aggregation of the molecules in solution. A theory of zero angle x ray scattering from solutions, relating the scattering to the osmotic pressure, is presented and compared with the observed scattering from sucrose and several salt solutions. The sucrose data agree with the theoretical scattering to ±3%, as a function of concentration, up to 20% solutions. The scattering from NaCl, KCl, and $NaNO_3$ also agrees well with the theory. Duplicate protein scattering data on two small angle x-ray machines, one with a slit separation of 10 cm and the other of 50 cm, permit a comparison of the slit height correction factors necessary for the different geometries. However, the location of the focal spot relative to the first slit is the determining factor for the form of the observed rocking curves. A calculation of the rocking curves for several different focal spot locations and sizes is given. When the appropriate weighting functions are used the protein data observed on the two machines agree to within the precision of the measurement. (Dissertation Abstr., 24: No. 9, March 1964)

20036 AN INVESTIGATION OF STERIC INHIBITION OF RESONANCE IN LIQUID SCINTILLATORS. Richard Lawrence Taber. Thesis, Albuquerque, N. Mex., Univ. of New Mexico, 1963. 145p.

In order to investigate the steric inhibition of resonance in liquid scintillators, a number of 2'',3'-disubstituted p-quaterphenyls were prepared. In addition 2'',3',5',6''-tetramethyl-p-quaterphenyl, 2,2'-dimethyl-p-quaterphenyl, and 2,2'-dimethyl-p-terphenyl were synthesized. The preparations are described. The compounds were tested as primary liquid scintillation solutes. The 2,2'- and 2'',3'-dimethyl-p-quaterphenyls and 6,6-dicarbethoxy-3,9-diphenyl-5,7-dihydrodibenzo[a,c]cycloheptadiene were found to be excellent scintillators. 2,2'-dimethyl-p-terphenyl was found to be a fair scintillator, and the p-quaterphenyl related azepine, thiepin, and selenepin were found to be very poor scintillators. 2'',3',5',6''-tetramethyl-p-quaterphenyl was a very poor scintillator, and exhibited the ultraviolet absorption spectrum of a biphenyl derivative. The square of the cosine of the estimated angle of twist about the 1',1''-bond in 2,7-diphenylfluorene, 2,7-diphenyl-9,10-dihydrophenanthrene, 3,9-diphenyl-5,7-dihydrodibenz[c,e] oxepin, and the p-quaterphenyl related 5,7-dihydrodibenzo [a,c]cycloheptadiene, 2'',3'-dimethyl compound, and the tetramethyl compound was plotted against the relative pulse-height of these compounds at a concentration of 3×10^{-3} mole per liter. A straight line could be drawn through the points, with the exception of the tetramethyl compound, which did not exhibit the scintillation properties of a p-quaterphenyl, but of a biphenyl. Other data also obtained regarding the compounds' ultraviolet absorption spectra and ultraviolet induced fluorescence spectra are given. (Dissertation Abstr., 24: No. 9, March 1964)

Radiation Chemistry and Radiochemistry

Refer also to abstract 20860.

20037 (BNL-6978) RADIATION YIELDS AND REACTIONS IN DILUTE INORGANIC SOLUTIONS. A. O. Allen (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT(30-2)-Gen-16. 25p.

A review is presented on the problems of yields of free radicals formed by water radiolysis in neutral, acid, and basic solutions. It is indicated that discrepancies in the data for neutral solutions suggest that a hitherto unrecognized type of free radical may possibly be involved. Data on basic solutions appear discordant. The relative reactivities of various inorganic substances in aqueous solution towards hydroxyl radicals, hydrogen atoms, and solvated electrons are tabulated. The question of the identity of the radical formed in the Fenton reaction is discussed. 53 references are included. (P.C.H.)

20038 (COO-1044-13) BLEACHING OF Cl_2^- MOLECULE-ION CENTERS IN KCl - Pb (thesis). Special Report No. 2. John A. Reffner (Illinois Inst. of Tech., Chicago). June 1960. Contract AT(11-1)-1044. 48p.

The isothermal rates of bleaching of Cl_2^- molecule-ions in x-irradiated KCl – Pb were measured. The bleaching process is found to follow second order kinetics, i.e. $d(Cl_2^-)/dt = k(Cl_2^-)^2$. A mechanism for bleaching is proposed in which holes are freed from Cl_2^- molecule-ions and these migrate through the lattice until electron-hole recombination takes place with the electron trapped by the lead ion ($Pb^{2+} \cdot e$). Assuming the proposed mechanism to be correct the activation energy for bleaching (0.50 ev) is approximately the energy for freeing positive holes from Cl_2^- molecule-ions in KCl – Pb. (auth)

20039 (COO-1044-14) CHARACTERIZATION OF COLOUR CENTRES IN SODIUM FLUORIDE (thesis). Special Report No. 3. Kwasi Amenu-Kpodo (Illinois Inst. of Tech., Chicago). Jan. 1963. Contract AT(11-1)-1044. 70p.

X-ray induced color centers in sodium fluoride at various temperatures have been investigated. The peak positions of F, M, V, and R-bands have been fixed. Bleaching experiments have revealed the presence of underlying bands of the F-band. The growth of the F-center as a function of temperature was studied in accordance with the two stage mechanism proposed by Novwick and Gordon. Liquid nitrogen temperature growth rate of the F-band shows a larger initial rate of increase than was predicted by the Gordon and Bauer equation. (auth)

20040 (COO-1044-15) COLOR CENTER PHENOMENA IN ZONE-REFINED POTASSIUM CYANIDE. Special Report No. 4. Sherman Susman (Argonne National Lab., Ill.). June 1963. Contract AT(11-1)-1044. 206p.

Thesis submitted to Illinois Inst. of Tech., Chicago.

The close analogy that exists between KCN and KBr has prompted the present investigation. The purpose of this study has been: (1) To ascertain if color centers of the type that occur in the alkali halides would appear in

the pseudo alkali halides. (2) To determine what effect, if any, the dipolar CN^- ion would have on the optical properties of these centers. Vacuum melting of KCN transforms oxygen-containing impurities (e.g., formate, oxalate, carbonate) to OCN^-. Zone melting removes the cyanate contamination with an effective segregation coefficient of 0.7. The distribution of infrared-active impurities has been followed by absorption spectrometry in the crystalline matrix and an infrared identification table has been presented for the common anionic impurities in KCN. Cation contamination has been monitored by emission spectroscopy. Nominally pure, KCN single crystals have been subsequently grown from zone-refined material using a modified Bridgman method. Exposure of KCN crystals to 50 kv x rays produces electron-excess centers, hole centers, and impurity-band absorptions. The F and M centers in the cubic form of KCN (a = 3.26 Å) are analogous to those observed in KBr (a = 3.29 Å). The absorption bands in KCN are at higher energies than in KBr but within the limits of accuracy observed for the empirical Ivey relations. Broadening of the bands is induced by the additional degrees of freedom of the dipolar CN^- ion. To a first approximation, when only ground states and first excited states are involved in an optical dipole transition, the energy level separations in electron-excess centers are not altered by the CN^- dipole. X-ray irradiation produces large concentrations of M centers in KCN as contrasted to the observed behavior in KBr. At least six anisotropic absorption bands are attributed to the M center, with two of the prominent bands lying in the F-band region. The hydrogen-molecule analog for the F_2 model of the M center has been examined in a continuum approximation. Viewed in this manner, the M_1 band corresponds to the $^1\Sigma_g^+ \rightarrow {}^1\Sigma_u^+$ transition; and the M_2 and M_2' bands are associated with the $^1\Sigma_g^+ \rightarrow {}^1\pi_u$ transition. The M_3 and M_3' absorption bands in KBr are not temperature dependent and may be transitions to levels lying close to or within the conduction band. The low intensity M_4 band appears in a spectral region appropriate to a spin forbidden transition. Weak, unassigned M_5 and M_6 bands lie in the high energy tail of the M_3 band. The splitting of the doubly degenerate $^1\pi_u$ level by the crystalline field gives rise to the discrete M_2 and M_2' transitions. The splitting is fifty per cent greater in KCl (a = 3.14 Å) than in KBr. It is five times greater in KCN than in KBr for almost equal lattice parameters. The magnitude of the splittings in KCl, KBr, and KCN is in the same sequence as the spectrochemical series for ligands of coordination compounds. If the molecular axis of the M center is taken as the z axis, the point ion approximation gives the wrong ordering for the π_{yu} and π_{xu} energy levels. Electron repulsion and ionic polarizabilities probably dominate the relative energies of the M_2 and M_2' absorption bands and the separation between them. (auth)

20041 (MMPP-167-6) ENERGETIC RECOIL ATOM REACTION MECHANISMS. Progress Report No. 3, February 15, 1962–February 15, 1963. Adon A. Gordus (Michigan. Univ., Ann Arbor. Michigan Memorial-Phoenix Project). Mar. 1963. Contract AT(11-1)-912. 35p. (ORA-3710-3-P)

Kinetic Energy Moderation, Reaction Probability, and the Neutron "Cooling-Down" Model. The lower and upper thresholds of the reaction probability curve are discussed, and the analogy of hot-atom reactions with neutron cooling-down is pointed out. Equations for neutron cooling-down are developed with the perturbation effect, and several approximate solutions are evaluated. Halogen Gas-Phase Organic Yields. Limiting organic yields are tabulated for the reactions of hot atoms from the nuclear reactions $^{80m}Br(I.T.)^{80}Br$, $^{79}Br(n,\gamma)^{80}Br$, $^{37}Cl(n,\gamma)^{38}Cl$, and $^{127}I(n,\gamma)^{128}I$, with various hydrocarbons and halogenated hydrocarbons. The yields increase in the order $^{80m}(Br(I.T.)$, ^{80}Br, ^{38}Cl, and ^{128}I and increase with the number of hydrogens in the target. ^{38}Cl Gas Phase Bond Rupture. Data on ^{38}Cl remaining chemically bound following (n,γ) activation are tabulated for various chlorinated methanes and are plotted as a function of the normalized gamma ray energy required for dissociation. Constant-Flow Regulator. A pressure regulator was modified for increased inlet pressure when the temperature of a gas chromatography column is increased, so that a relatively constant exit flow rate is obtained. Programmed Temperature Regulator. A simple, inexpensive regulator was devised for increasing the temperature of a gas chromatography unit at an adjustable linear rate. Chromatography Peak Integrator. A method was devised for recording the total activity of each compound separated by the column with no increase in dead time. The pulses from a GM tube are fed into a rate meter and a decade scaler with a selector for actuating a mechanical register. (D.L.C.)

20042 (USNRDL-TR-718) RADICAL YIELDS IN IRRADIATED AROMATICS. J. I. McAndrews, T. H. Anderson, and S. B. Martin (Naval Radiological Defense Lab., San Francisco). Jan. 31, 1964. 35p. (AD-434046)

The relatively high efficiency of production of free radicals which become stabilized at liquid nitrogen temperature during the radiolysis of several aromatic hydrocarbons demonstrates the quantitative importance of these intermediates in the mechanism of radiation decomposition. The required measurement of $G(R\cdot)$ values necessitated the indirect approach of comparing partially saturated ESR absorption spectra at high powers and then evaluating the extent of saturation in an independent measurement. $G(R\cdot)$ values are: benzene, 0.32; toluene, 0.53; biphenyl and naphthalene, 0.10. The results average about one-third of the corresponding values for radiolysis at room temperature. (auth)

20043 DOSE DISTRIBUTION IN ALKALI HALIDE SALT CRYSTALS IRRADIATED BY AN ELECTRON BEAM. V. N. Rudenko. At. Energ. (USSR), 16: 151-2(Feb. 1964). (In Russian)

In order to clarify the luminescence phenomena in crystals, the distribution of the absorbed energy of an electron beam passing through a crystal must be known; therefore, the energy losses of a betatron beam passing through alkali halides were investigated, with special attention to the dose distribution in depth, the lateral and back scattering, and the depth of the penetration. The maximum energy of the accelerated electrons was 15 Mev. A small ionization chamber, with a volume ranging from 0.2 to 0.4 cm^3, prepared from the crystal under study was used for measuring the energy losses. Dose distribution measurements in KCl, KBr, and KI crystals bombarded with 7.3-Mev electrons showed that the curve of the absorbed energy vs the depth of penetration exhibits a maximum at a certain distance from the surface; the depth depended on the chemical composition and the electron energy. The data did not agree with calculated values, therefore the dose distribution was determined in NaCl and KI crystals under consideration of the back scattering of the electrons. It was found that the intensity of back scattering increases markedly with the increase of the atomic number; the contribution of back scattering to the total dose was 9%

for NaCl and 27% for KI. Thus, lengthening of the path of the electrons in materials with high effective atomic number causes large local losses of the beam. (TTT)

20044 CONTRIBUTIONS TO PROGRESS IN NUCLEAR, RADIO- AND RADIATION CHEMISTRY (REPORT ON THE GENERAL MEETING OF GDCh AT HEIDELBERG). L. Wiesner. Atomwirtschaft, 9: 113-15(Mar. 1964). (In German)

Research progress on radiochemical separation, uses of activation analysis, and chemical and physical radiation effects is discussed. (M.C.G.)

20045 RADIOCHEMICAL REACTIONS IN THE PRESENCE OF QUARTZ. L. Holzapfel, G. Fila, and J. Lehmann (Max-Planck-Institut für Silikatforschung, Zweigstelle, Berlin). Beitr. Silikose-Forsch., Sonderband, 4: 197-201 (1960). (In German)

If solutions of organic compounds, such as amine acids or carbohydrates, are treated with γ rays, they show chemical changes and differences that are related to whether or not they contain quartz. Activation and radiation from the quartz produces these markedly accelerated reactions. The luminescent properties of the quartz increase with the degree of dispersion and heating, as well as with the intensity of the radiation and duration of the radiation period. A quartz-dependent reaction is shown by aqueous glycine solutions, where nitrite is formed. The solutions were irradiated in sealed plastic cells, for it is absolutely essential to prevent exposure to oxygen. The results are dependent on the duration of the radiation treatment. Not all amino acids give the same reaction, but the greatest difficulty is the limited sensitivity of the methods used to detect the reaction products. Nitrite formation is especially significant because of its biologically injurious effects. The minimal radiation time necessary to activate the quartz to produce a measurable effect can be demonstrated by a photomultiplier. After γ radiation of the quartz for only 1 sec, 1300 scintillations are produced in 2 sec, and after radiation of 5 sec, 44000 scintillations are produced within 10 sec. These effects can be recorded on film using an exposure of 15 hr. The results show that an effect is produced with very small radiation exposure times. (BBB)

20046 A COMPARISON OF THE SCINTILLATION AND PHOTOFLUORESCENCE SPECTRA OF ORGANIC SOLUTIONS. J. B. Birks (Univ. of Manchester, Eng.), C. Lloyd Braga, and M. D. Lumb. Brit. J. Appl. Phys., 15: 399-404 (Apr. 1964).

The scintillation spectra, excited by ^{32}P β radiation, and the photofluorescence spectra, excited by ultra-violet radiation, of solutions of TP, PPO, POPOP, DPA and pyrene in toluene and other aromatic solvents have been observed under similar conditions. All the spectra are found to be independent of the mode of excitation, within the experimental error. The influences of dissolved oxygen and of excimer formation on the observed spectra are considered. (auth)

20047 HYDROXYL RADICALS IN THE γ-RADIOLYSIS OF AQUEOUS BENZENE SOLUTIONS. Minoru Tsuda (Government Chemical Industrial Research Inst., Tokyo). Bull. Chem. Soc. Japan, 36: 1582-5(Dec. 1963).

Experiments were made in order to prove the hypothesis that the hydroxyl radical plays an important role in the oxidation of organic compounds by γ radiolysis in aqueous solutions. Nitrous oxide and hydrogen peroxide were found to be capable of converting radioinduced hydrogen atoms (or their stoichiometrically-equivalent species) into hydroxyl radicals. In the γ radiolysis of aqueous benzene solutions in the presence of nitrous oxide or hydrogen peroxide, the yield of the oxidation products from benzene was found to equal the sum of the yields of hydrogen atoms and hydroxyl radicals from water. (P.C.H.)

20048 MAKING CHEMICALS VIA RADIATION, DOW'S ETHYL BROMIDE PROCESS. D. E. Harmer and J. S. Beale (Dow Chemical Co., Midland, Mich.). Chem. Eng. Progr., 60: No. 4, 33-6(Apr. 1964).

Laboratory equipment, process development, and operating experiences in the radiation processing of ethyl bromide are discussed and described. A flowsheet of the process is given. (P.C.H.)

20049 THE EFFECT OF GAMMA IRRADIATION ON GLUCOSAMINE. N. K. Kochetkov, L. I. Kudryashov, and T. M. Senchenkov (Inst. for Chemistry of Natural Compounds, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 154: 642-5(Jan. 21, 1964). (In Russian)

Preliminary data are presented on the ^{60}Co irradiation of 0.05M solutions of glucosamine, one of the biologically important aminosugars. The intensity of the ^{60}Co dose was 5×10^{16} ev/ml-sec; the total dose was varied from 0.3×10^{19} to 18×10^{19} ev/ml. The changes in the concentration of the glucosamine and its N-acetyl derivative were determined by paper chromatography. Sections of the chromatogram were eluted with 50% CH_3COOH; the optical density of the glucosamine and N-acetyl glucosamine in these solutions was measured with wavelengths of 354 and 358 mμ, respectively. From an initial concentration of 3×10^{19} molecules/ml, the concentration of the glucosamine dropped to 2×10^{19} molecules/ml after a dose of 1×10^{19} ev/ml, and to 1×10^{19} molecules/ml after a dose of 8×10^{19} ev/ml. The concentration was unaffected by further irradiation. There was very little post-irradiation decomposition of the glucosamine after doses of 18×10^{19} ev/ml, and none at all after doses of 1.5×10^{19} ev/ml. The UV spectrum of the irradiated solutions showed a peak at 268-270 mμ; the intensity of the peak increased linearly with the dose. The pH of the solutions was not affected by the irradiation. (TTT)

20050 THE MECHANISM OF THE FORMATION OF MOLECULAR PRODUCTS IN THE RADIOLYSIS OF WATER. V. M. Byakov and B. V. Ershler. Dokl. Akad. Nauk SSSR, 154: 669-72(Jan. 21, 1964). (In Russian)

Four basically different mechanisms were proposed in the literature for the formation of H_2 and H_2O_2 when water is irradiated with gamma rays or electrons: (I) the recombination of radicals $H + H \rightarrow H_2$, $OH + OH \rightarrow H_2O_2$; (II) the formation and recombination of ions and free electrons; (III) the collision of excited and unexcited molecules of water $H_2O^* + H_2O \rightarrow H_2 + H_2O_2$; and (IV) the decomposition of an excited water molecule into H^* and OH^*, which then react to form $H_2 + OH$ and $H_2O_2 + H$ respectively. It is shown that schemes II, III, and IV predict that the inverse of the G yield for the molecular products increases linearly with C_A, the concentration of acceptor molecules. Only the first scheme predicts that the G yield decreases linearly with $3\sqrt{C_A}$, in agreement with empirical formulas. (TTT)

20051 RADIOLYSIS OF CYCLOHEXANE ADSORBED BY SYNTHETIC ZEOLITES. V. S. Gutyrya, A. A. Kachan, Yu. A. Kolbanovskii, L. S. Polak, Y. N. Nizelskii, and V. S. Frolova (Inst. of Polymer and Monomer, Academy of Sciences, Ukrainian SSR and Inst. of Naphthochemical Synthesis, Academy of Sciences, USSR). Dopovidi Akad. Nauk Ukr. RSR, No. 1, 82-4(1964). (In Ukrainian)

The effect of the chemical composition of the adsorbents (synthetic zeolites) on the composition of the products of

cyclohexane radiolysis was established. The assumption is advanced that for the formation of an adsorbent actively affecting radiolysis it is important that two cations should be present in the zeolite, one of them of variable valency. (auth)

20052 RADIOCHEMICAL POLYMERIZATION AND CYCLIZATION OF PHENYLACETYLENE AND METHYLACETYLENE. Alessandro delle Site and Aldo Mele (Comitato Nazionale per l'Energie Nucleare, Rome). Gazz. Chim. Ital., 93: 1279-87(Oct. 1963). (In Italian)

Phenylacetylene and methylacetylene samples were irradiated with a 6000°C ^{60}Co γ-ray source of intensity 7270 r/min. Phenylacetylene polymerization increased with the dose to 10.55% polymer at 132×10^6 r. Melting points (m.p.) and molecular weights (m.w.) are tabulated for some intermediate doses; m.w. increased from 396 to 473 as dose varied from 18.4×10^6 to 112×10^6 r. The infrared spectrum is the same as that from a Ziegler-catalyst polymerized sample; this and hydrogenation data (uptake 17%) are explained by a structure with conjugated double bonds. Ultraviolet spectrum and m.p. identified 1,3,5-triphenylbenzene as a second product. The polymer could be fractionated by repeated extraction with heptane. Solutions of phenylacetylene in benzene were irradiated by 49.3×10^6 r and yield determined as a function of concentration. From 40% to 80% (phenylacetylene by wt), G (molecules/100 ev) ranged from 16.9 to 19.5; G for pure phenylacetylene was 11.1. Methylacetylene was studied in similar fashion; max yield of polymer found was 7.38%, at max dose used, 181×10^6 r, having a m.w. of 300. The last figure was the highest of m.w.'s found. Trimeric products were 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene and others. The infrared spectrum of the polymer, which was sensitive to air, showed peaks in the hydroxyl, allene, ketone, and acid regions. Hydrogenation indicated the presence of double bonds. The kinetics of both polymerizations were discussed very briefly; the rates show a slight decrease with time. (BBB)

20053 RADIATION CHEMISTRY OF HYDROCARBONS. PART 11. TOLUENE-α-d_3. Juerg Hoigné and Tino Gaeumann (Eidgenossische Technische Hochschule, Zurich). Helv. Chim. Acta, 47: 260-3(1964). (In German)

The products produced by γ rays in liquid toluene-α-d_3 were compared with those measured in toluene-α-d_0. The overall polymer-formation was hardly affected by the deuteration but the yield of the individual dimeric compounds was characterized by the fact that the formation of the benzyl radicals becomes about 40% of the value in protonated toluene. This resulted in a benzyl formation of 17%, a benzyl-toluene formation of 40%, and an increased yield of all the bitolyls as compared with the values found for toluene-α-d_0. (auth)

20054 RADIATION CHEMISTRY OF HYDROCARBONS. PART 12. BENZENE-TOLUENE AND DEUTERATED COMPOUNDS. Juerg Hoigné and Tino Gaeumann (Eidgenossische Technische Hochschule, Zurich). Helv. Chim. Acta, 47: 590-601(1964). (In German)

Further information on the radiation chemistry of aromatic liquids was obtained by a detailed analysis applied mainly to the dimeric products formed by the gamma irradiation of mixtures of benzene and toluene and their deutero-compounds (benzene-d_6-toluene-d_0 and benzene-d_0-toluene-α-d_3). Diphenylmethane types of molecules were not formed by a reaction of dehydroaromatic species (benzene). The different products were generally produced according to the expected mixture law when corrections are allowed for the competing chemical reactions. In the perdeuterobenzene-toluene system, however, an energy transfer from benzene-d_6 to toluene is postulated to explain the yields obtained. The isomer distribution of the three phenyltoluenes can be compared with the statistical values. (auth)

20055 RADIATION CHEMISTRY OF HYDROCARBONS. PART 10. LET EFFECT IN TOLUENE. J. Hoigné (Eidgenossische Technische Hochschule, Zurich), W. G. Burns, W. R. Marsh, and T. Gaeumann. Helv. Chim. Acta, 47: 247-59(1964). (In German)

Liquid toluene was irradiated with ^{60}Co γ rays, with protons of energies from 1.8 to 0.5 Mev, and with α particles of 1.5 and 0.7 Mev with a dose of 10 and 30 Mrad at 20 to 25°C. The G values increased with increasing LET (linear energy transfer) from 0.11 to 0.58 for hydrogen, from 0.95 to 1.55 for polymers, from 0.055 to 0.061 for bibenzyl, from 0.034 to 0.042 for bitolyls, 0.020 to 0.066 for benzyltoluene, and 0.028 to 0.051 for benzyldihydrotoluene. The isomer ratio of the six bitolyls changed appreciably but the ratio of the three benzyltoluenes remained constant. The yield vs LET dependence showed different characteristics for the different products formed. The competition of reactions of first and second order with respect to primary reactive species are discussed. The results sustained the hypothesis that benzyltoluene is formed mainly by a second order reaction of reactive primary particles in the spurs. If this molecule formation is due to a radical recombination, then a small spur-radius must be accepted for this reaction. (auth)

20056 RADIATION PROTECTION OF AQUEOUS POLYVINYLPYRROLIDONE SOLUTIONS BY THIOUREA. P. M. Kopp and A. Charlesby (Royal Military Coll. of Science, Swindon, Eng.). Intern. J. Radiation Biol., 7: 173-96(Aug. 1963).

A detailed study was made of radiation protection effects in a model macromolecular system—polyvinylpyrrolidone in water, with thiourea acting as the protecting additive. The effects of polymer concentration, dose-rate and additive concentration on the gelation dose were determined. In the absence of polymer, dilute thiourea solutions show rapid destruction of thiourea on irradiation, with a smaller reduction in its subsequent protective ability. It is concluded that the major form of protection is offered by thiourea against the indirect effect of radicals produced in the water. Further protection occurs by H-transfer to polymer radicals; these constitute true protection, and the polymer is unaltered. Furthermore, thiourea can be linked into polymer giving a modified stabilized product. The great ability of thiourea to protect, even at very low concentrations, is ascribed to the thiol–thione equilibrium in solution, which allows a chain reaction form of protection. This was confirmed in a range of other additives. (auth)

20057 THE MECHANISM OF HYDROGEN FORMATION IN THE RADIOLYSIS OF CYCLOHEXANE AND OTHER HYDROCARBONS. Sam Z. Toma and William H. Hamill (Univ. of Notre Dame, Ind.). J. Am. Chem. Soc., 86: 1478-83(Apr. 20, 1964).

The γ radiolyses of liquid alkanes with and without added iodine and methyl iodide or olefins were investigated. The systems and yields were: $G(H_2)$, $G(CH_4)$, and G(HI) in cyclopentane, n-hexane, 3-methylpentane, and 2,4-dimethylpentane, each containing 2×10^{-2} M iodine and up to 0.8M methyl iodide; $G(c\text{-}C_5H_8)$ and $G(c\text{-}C_5H_9I)$ in cyclopentane–methyl iodine; $G(c\text{-}C_6H_{10})$, $G(c\text{-}C_6H_{11}I)$, and $G(C_{12}H_{22})$ in cyclohexane–methyl iodide–iodine; $G(H_2)$, G(HD), and $G(D_2)$ for 1% cyclohexene-d_{10} in cyclohexane and 1.5% cy-

cyclohexene-d_{10} in cyclopentane. Ultraviolet absorption of products was measured in vacuo for cyclohexane, cyclopentane, n-hexane, 0.05M cyclohexene in cyclohexane, and 0.05M cyclopentene in n-hexane at 20°C, and for 0.1M cyclohexene and 0.1M cyclopentene in 3-methylpentane glass at −196°C. The results are interpreted in terms of electron attachment and charge transfer as well as free-radical reactions. A yield of 0.5 molecule/100 ev or greater was found in cyclohexane for an organic product not previously reported. (auth)

20058 THE RADIOLYSIS OF DEAERATED AQUEOUS SOLUTIONS OF 2-PROPANOL CONTAINING NITROUS OXIDE. J. T. Allan and C. M. Beck (Mellon Inst., Pittsburgh). J. Am. Chem. Soc., 86: 1483-8(Apr. 20, 1964). (RRL-120)

Deaerated aqueous solutions of 2-propanol containing nitrous oxide were irradiated with 2.5 Mev electrons and the yields of nitrogen, hydrogen, acetone, and hydrogen peroxide measured as a function of pH, solute concentration, and radiation dose rate. The effects of additional solutes on the product yields were also investigated. The results were interpreted on the basis of the primary formation of two reducing species in irradiated water—the hydrated electron and a species that behaves as a hydrogen atom. The yields, reactivity, and possible modes of formation of these species are discussed. (auth)

20059 VO^{2+} AND X-RAY PRODUCED V^{2+} IN TUTTON SALT. Robert H. Borcherts and Chihiro Kikuchi (Univ. of Michigan, Ann Arbor). J. Chem. Phys., 40: 2270-5 (Apr. 15, 1964).

The electron spin resonance spectrum of the vanadyl ion (VO^{2+}) in single crystals of $Zn(NH_4)_2(SO_4)_2 \cdot 6H_2O$ is studied and the properties of x-ray produced V^{2+} are compared to those of the V^{2+} grown directly into the same host lattice. In the unirradiated samples the V−O axis is found to have three possible orientations with populations in the ratio 20 : 5 : 1. For the most populous position the spin Hamiltonian parameters at X band are $S = \frac{1}{2}$, $g_x = 1.9813$, $g_y = 1.9801$, $g_z = 1.9331$, $A_x = 0.007120$/cm, $A_y = 0.007244$/cm, $A_z = 0.018281$/cm, and $Q' = 7 \times 10^{-5}$/cm with the x, y principal axes of the g and A tensor being displaced from each other by 23°20′. Furthermore, the vanadyl hyperfine lines show an additional anisotropic structure of five lines, absent in deuterated samples. The parameters for V^{2+} at K band in both the as-grown and irradiated crystals are $S = 3/2$, $g_z = 1.9717$, $g_y = 1.9733$, $D = -0.15613$/cm, $E = -0.02280$/cm, and $A = -0.00825$/cm. A study of the effect of x-ray dose upon the line intensity was made. An impurity model of a vanadyl pentahydrate complex associated with a water molecule vacancy is proposed. (auth)

20060 SELF-ACTIVATED LUMINESCENCE OF M^{2+} NIOBATES AND TANTALATES. A. Wachtel (Westinghouse Electric Corp., Bloomfield, N. J.). J. Electrochem. Soc., 111: 534-8(May 1964).

Among 22 compounds examined for photoluminescence, only $Mg_4Nb_2O_9$, $CaTa_2O_6$, and the metaniobates of Mg, Ca, Zn, and Cd show appreciable room temperature emission. With the exception of $Mg_4Nb_2O_9$, all of these have the columbite structure; moreover, the only essentially nonluminescent columbite-type compound noted was $ZnTa_2O_6$. The absorption edges of the luminescent niobates lie at shorter wavelengths than those of otherwise similar compositions. This indicates a relationship between luminescence and the separation of energy states within the Nb−O bond, as influenced by structure. (auth)

20061 THE THERMAL DECOMPOSITION OF IRRADIATED NICKEL OXALATE. Joseph Jach (State Univ. of New York, Stony Brook) and Maurice Griffel. J. Phys. Chem., 68: 731-6(Apr. 1964). (BNL-7652).

The thermal decomposition of unirradiated and reactor-irradiated dehydrated nickel oxalate was studied in the temperature range 253-360°C. Reaction begins at surface nuclei and there is evidence that the activation energy for nucleus formation is less than for the growth process. In the temperature regions where the amount of decomposition due to the growth of existing nuclei overshadows that due to growth of newly formed nuclei, the acceleratory region is described by a t^2 law. The value of the fraction of total decomposition (α) at the point where the rate is a maximum (the point of inflection) changes drastically with temperature and irradiation. Irradiation appears to increase the number of potential nuclei but does not enhance the growth rate. (auth)

20062 EVIDENCE FOR THERMAL HYDROGEN ATOMS AND OTHER REACTIVE SPECIES IN IRRADIATED LIQUID HYDROGEN HALIDES. Robert C. Rumfeldt and David A. Armstrong (Univ. of Alberta, Can.). J. Phys. Chem., 68: 761-7(Apr. 1964).

The effects of each of the scavengers, ethylene, chlorine, and bromine, on the hydrogen yield from liquid HCl irradiated at −79°C can be interpreted in terms of a competition between HCl and the scavenger, S, for thermal hydrogen atoms. The observed rate constant ratios, k_{H+HCl}/k_{H+S} (1.7×10^{-3} for $S = Cl_2$, 0.79×10^{-3} for $S = Br_2$, and 5.9×10^{-3} for $S = C_2H_4$), are in agreement with ratios calculated on the basis of the available kinetic data for hydrogen atom reactions. In contrast to these compounds, sulfur hexafluoride does not have an appreciable effect on the hydrogen yield. The use of bromine as a scavenger in mixtures of HCl and HBr permitted an evaluation of the ratio k_{H+HBr}/k_{H+Br_2}. The value observed in mixtures containing less than 10 mole % HBr is in excellent agreement with the well-established and virtually temperature independent value (0.12 ± 0.02) obtained from investigations of the gas phase bromination of hydrogen. The results provide convincing evidence that the more easily scavenged of the hydrogen-forming species in liquid hydrogen halides (H′) is a thermal hydrogen atom and in liquid HCl $G_{H'} = 2.2 \pm 0.3$. It is also shown that in HCl−HBr mixtures the yield, G_H', of the remaining hydrogen-forming species increases much more rapidly than $G_{H'}$ as the proportion of HBr is increased. Reasons for believing that excited molecules (or hot H atoms formed from them) are responsible for a significant portion of the hydrogen yield from HBr are presented. (auth)

20063 MASS SPECTRA, RADIOLYSIS, AND PHOTOLYSIS OF PHENYL ALKYL KETONES. Seymour Meyerson (American Oil Co., Whiting, Ind.). J. Phys. Chem., 68: 968-9(Apr. 1964).

Previous results on the radiolysis, photolysis, and mass spectra of n-butyrophenone are discussed, and partial mass spectra of phenyl alkyl ketones are reported. Spectra were previously reported to be so similar as to be useless for predicting how radiolytic reactions of the ketones might differ. This is disputed. The statement cited is correct if only the grossest spectral features are taken into consideration. It was concluded that interpreted with care, mass spectra can furnish helpful guidance in exploring radiolytic systems. (P.C.H.)

20064 RADIOLYSIS OF POLYISOBUTENE. PART I. YIELDS OF FRACTURES, DOUBLE BONDS, AND GAS. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. A, 2: 1699-1711(Apr. 1964).

Purified polyisobutene with approximately a random

molecular weight distribution and a number-average molecular weight of 3.5×10^6 was irradiated in vacuo at about 25°C with 4 Mev electrons. The degradation of the polymer was studied by osmometry and viscometry and the G (fracture) value determined as 4.1. The G value for total unsaturation was determined as 5.3 by a chemical method suitable for olefins branched in the vicinity of the double bond. Little or no internal unsaturation was detected by ozonolysis of the irradiated polymer. Hydrogen and methane were formed with G values of 1.3–1.6 and 0.8–0.5, respectively. At doses greater than about 10 Mrad all the above G values decreased. The G value for isobutene formation (≤0.1) remained approximately constant up to a dose of at least 150 Mrad. On lowering the temperature of irradiation to −196°C the yield of fractures was markedly decreased while the yield of hydrogen plus methane was scarcely affected. This is interpreted as evidence that the degradation reaction is due predominantly to the direct fracture of carbon–carbon bonds rather than to any reaction associated with gas formation. The observed ratio of double bonds to fractures is shown to be consistent with this interpretation. (auth)

20065 RADIOLYSIS OF POLYISOBUTENE. PART II. INFRARED AND ULTRAVIOLET ABSORPTION SPECTRA. G. M. C. Higgins (Natural Rubber Producers' Assn., Welwyn Garden City, Herts, Eng.) and D. T. Turner. J. Polymer Sci., Pt. A, 2: 1713-19(Apr. 1964).

Purified polyisobutene was irradiated in vacuo with 4 Mev electrons and the changes in infrared and ultraviolet absorption recorded. $R_1R_2C=CH_2$ groups accounted for about 60% of the total unsaturation, and evidence could be adduced for the formation of $R_1R_2C=CHR_3$ groups. About one tert-butyl group was formed per double bond. Qualitative evidence was obtained for formation of the group $R_1-CH_2-CH_2-R_2$. Conjugated diene groups are formed proportional to the dose up to the maximum investigated of 1400 Mrad (G value about 0.1). (auth)

20066 RADIOLYSIS OF POLYISOBUTENE. PART III. EFFECT OF ADDITIVES. D. T. Turner (Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. A, 2: 1721-9(Apr. 1964).

The effect of various liquid additives on the degradation of polyisobutene exposed to 4 Mev electrons was studied by solution viscometry and by measurement of gas volatile at −196°C. At a concentration of about 10^{-4} mole/g some additives result in an increased yield of fractures, the maximum observed being about 20% with nitrobenzene, presumably due to the scavenging of polymer radicals that otherwise would combine. At higher concentrations most additives result in a decrease in the yield of fractures. Thus, 2×10^{-3} mole/g thiophenol decreases the yield by about two-thirds and itself suffers sensitized decomposition as evidenced by an increase in the yield of gas from the irradiated mixture. In the simplest case, di-n-butyl disulfide has a symmetrical effect in suppressing part of the yield of fractures and gas. This is consistent with the view that a proportion of the fractures is associated with gas formation. (auth)

20067 COPOLYMERIZATION OF TETRAFLUOROETHYLENE WITH ETHYLENE INDUCED BY IONIZING RADIATION. Yoneho Tabata, Hiroshi Shibano, and Hiroshi Sobue (Tokyo Univ.). J. Polymer Sci., Pt. A, 2: 1977-86 (Apr. 1964).

Radioinduced copolymerization of tetrafluoroethylene with ethylene was carried out. It was found that the composition of copolymers varied continuously in a wide range of molar concentrations of one component. The melting point of the copolymers obtained varied continuously with the molar concentration of one component in monomer mixture between the melting points of both homopolymers. X-ray diffraction measurements showed that the copolymer obtained was crystalline. The copolymerization proceeds by a radical mechanism. It was concluded that both the energy transfer to ethylene from tetrafluoroethylene during irradiation and great affinity of hydrogen atom for fluorine atom would play an important role in the copolymerization. (auth)

20068 THE EFFECT OF RADIOACTIVE RADIATION ON ELECTRIC CHARGE AND THE POSSIBILITIES OF ITS PRACTICAL USE. Josef Neruda. Jaderna Energie, 9: 393-6(Dec. 1963). (In Czech)

The discharge of a static charge by radiation depends on the dielectric constant of the material. The loss in effective charge depends exponentially on the dose, and the discharge time is governed by the dose rate. The charge loss was 70% for an 11-r beta dose on polyvinylacetate, 50% for a 7-r beta dose (Sr^{90}) on polyvinylacetate, 40% for a 4-r beta dose on Carnauba wax, 50% for a 4-r gamma dose on mylar, 30% for an 0.8-r gamma dose on polyethylene containing iron oxide, and 15% for a 1.2-r gamma dose on an artificial organic resin. Typical discharge curves are shown as a function of time for the various materials. Methods of measuring the charge on the material are discussed. (TTT)

20069 MAKING USE OF BINARY MIXTURES. Anton Benadik and I. Bucina (Inst. for the Study and Application of Radioisotopes, Prague). Jaderna Energie, 10: 21-2(Jan. 1964). (In Czech)

A calculation scheme was developed for determining the content of radioactive components in an element or a binary compound. The method was based on repeated measurements of radiation intensity by means of an ionization chamber after a given time interval. In order to simplify the calculations, a nomogram was created, allowing the proportion of ^{42}K in a mixture containing ^{38}Cl, obtained by the irradiation of KCl in a reactor, to be conveniently determined. The data needed for constructing similar nomograms are given in tabular form for KCl, NaCl, Hg, Sb, Re, and Zn. (TTT)

20070 POLYMERIZATION OF α-METHYLSTYRENE BY ELECTRON IRRADIATION. Dietrich Braun, Gert Heufer, and Wolfgang Seufert. (Deutsches Kunststoff-Institut, Darmstadt, Ger.). Kolloid-Z., 194: 2-4(Jan. 1964). (In German)

Ampoules of α-methylstyrene sealed under vacuum were irradiated with 1-Mev electrons in a type JS Van de Graaff generator; comparative experiments with γ rays were carried out with a ^{60}Co source of 3000°C. High doses of electrons (ca. 10^8 rad) are necessary for polymerization. The conversion is graphed as a function of dose at 0°C; it reaches a maximum plateau of 65% at 4×10^8 rad; this may point to radiolysis of the polymer at doses above this. Polymerization conversion increases with decreasing dose rate, when dose and temperature are held constant; and conversion increases with decreasing temperature (22% at −22°C; 10% at 15°C; <1% at 60°C), as has been found with γ rays. In the solid state between −40°C and −80°C the maximum yield is only about 5%. The molecular weights of all poly-α-methylstyrenes thus formed lie between 3000 and 12,000, independently of dose rate and temperature. All polymethylstyrenes formed in the liquid state have approximately the same tacticity independent of temperature (isotactic about 20%; syndiotactic about 80%). This corresponds to the tacticity of polymers formed cationically with Lewis acids. In the solid state the tacticity is: iso-

tactic 38%, syndiotactic, 62%, comparable with the tacticity of anionic polymerization. In the liquid state the tacticity and the sensitivity towards water indicate a cationic mechanism for the reaction. NMR studies also indicate a cationic mechanism. (BBB)

20071 POSSIBILITIES OF PREPARING SOME CARRIER-FREE ISOTOPES BY ION EXCHANGE AND SELECTIVE ABSORPTION. Tamas Lengyel (Orszagos Atomenergia Bizottsag Izotop Intezete, Budapest, Hungary). Magy. Tud. Akad. Kem. Tud. Oszt. Kozlemen., 20: 433-9(1963). (In Hungarian)

Theoretical aspects of producing carrier-free isotopes are discussed with reference to mathematical considerations. It is noted that producing a carrier-free isotope often represents the difficult problem of separation of the desired product from the irradiated target. For effective separation, the characteristics of the resin must be taken into consideration. The effects of ionic strength and resin selectivity in terms of the quotient of the corresponding distribution ratios are discussed. It is considered best to determine the area formed between the two distribution curves when plotting the change of elution factors with the logarithm of ionic strength. The value of elution factors determined at optimum ionic strength makes possible the prediction of separation efficiency for a given column. Application of the theory to practical problems is discussed and the following possibilities considered: production of carrier-free ^{147}Pm, starting with the nuclear reaction $^{146}Nd(n,\gamma)^{147}Nd \xrightarrow{\beta} {}^{147}Pm$, through separation of reaction products from irradiated target; the production of ^{143}Pr by the reaction of $^{142}Ce(n,\gamma)^{143}Ce \xrightarrow{\beta} {}^{143}Pr$, followed by ion-exchange chromatography. Another possibility is the production of ^{99m}Tc, for use in medical diagnosis, by the reaction $^{98}Mo(n,\gamma)^{99}Mo \overset{\beta}{\underset{\beta}{\rightleftarrows}} {}^{99m}Tc \xrightarrow{\gamma} {}^{99}Tc$. (TCO)

20072 LUMINESCENCE OF METEORITES. G. F. J. Garlick (Univ. of Hull, Eng.). Nature, 202: 171(Apr. 11, 1964).

Comments are made on the proton-excited luminescence of some stony meteorites. It is speculated that the high efficiency of the meteorite may be associated with a fluorescence sensitization of the manganese emission by another kind of impurity present. (P.C.H.)

20073 SPECIFIC TRITIUM LABELING BY THE WILZBACH METHOD. S. J. Angyal and C. Fernandez (Univ. of New South Wales, Sydney). Nature, 202: 176-7 (Apr. 11, 1964).

Evidence was found that in tritium labeling of (–)-inositol by the Wilzbach method, myoinositol is specifically labeled on C1 only since inversion occurs during the replacement of hydrogen by tritium. Evidence was found in the degradation of myoinositol. (P.C.H.)

20074 ON THE COPOLYMERIZATION OF AMINO ACIDS BY IRRADIATION WITH FAST ELECTRONS. G. Krampitz (Universität, Bonn), J. Wieneke, and H. G. Neumann. Naturwissenschaften, 51: 109(1964). (In German)

Studies were made of the copolymerization of amino acids with fast electrons to see if the results were similar to those obtained at thermal energies. Doses of 0.5 to 6.0 Mrad were used. (M.C.G.)

20075 ESR OF X-IRRADIATED SINGLE CRYSTAL OF HEXAMETHYLENEDIAMMONIUM ADIPATE. Michio Kashiwagi (Toyo Rayon Co., Tebiro, Japan). Nippon Kagaku Zasshi, 85: 91-6(Feb. 1964). (In Japanese)

ESR analysis of x irradiated single crystal of hexamethylenediammonium adipate indicates that; radicals result from the abstraction of an α hydrogen atom from the component adipate ion of the hexamethylenediammonium adipate, namely, $\cdots {}^{-}OOCCH(CH_2)_3COO^{-} \cdots$, and the orientation of radicals is different from that of molecules prior to irradiation. The spectra change with temperature. This is attributed to the change of β proton coupling constants of methylene groups in the radicals. The phenomena are analyzed in terms of anharmonic oscillation with large amplitude of the methylene groups, and the potential depth of the anharmonic oscillation is estimated to be approximately 10 kcal/mole. (auth)

20076 ABSOLUTE PHOTOPEAK EFFICIENCY FOR WELL TYPE NaI(Tl) CRYSTAL. D. Redon, G. S. Mani, J. Delaunay-Olkowsky, and C. Williamson (Centre d'Etudes Nucléaires, Saclay, France). Nucl. Instr. Methods, 26: 18-21(Feb. 1964).

The absolute efficiencies for a 2 × 1.75 in. well crystal having a 0.5 in. diameter and 1.58 in. depth have been measured. The efficiencies are given as a function of the well depth for various gamma ray energies. The efficiencies have also been measured for various absorbing media inside the well. The resolution of the crystal as a function of gamma energy is also given. (auth)

20077 EFFECTS PRODUCED BY IRRADIATION WITH NEUTRONS AND WITH GAMMA RADIATION ON THE YELLOW SERIES AND THE GREEN OF THE ABSORPTION SPECTRA EXCITED IN CUPROUS OXIDE. M. Grossmann and S. Nikitine (Université, Strasbourg). Physik Kondensierten Materie, 1: 277-95(1963). (In French)

The effects of irradiations with a reactor and with a ^{60}Co source on the green and yellow series of the excitonic absorption spectrum of cuprous oxide were studied. In the reactor irradiation experiments, the effects of fast neutrons were studied separately from those of thermal neutrons and of gamma rays. It is shown that the perturbations of the absorption spectra of Cu_2O by fast neutrons are very similar to those produced by an external electric field. They are also similar to those produced by quenching, which probably creates internal strains. Charged defects probably occur in the crystal during bombardment and these charged defects produce an internal electric field and strains. It is not possible to study separately the effects of the electric field and the effects of strains. The electric field can be evaluated by comparison of its effects on the excitonic spectrum with those of an external field. An evaluation of the rate of creation of defects by fast neutrons in the crystal was deduced. It is also shown that the effects of gamma rays are very different from those of fast neutrons. It is possible with gamma irradiations to decrease residual internal fields, which may exist in a crystal. (auth)

20078 METHOD FOR INVESTIGATING PARAMETERS OF RELAXATION PROCESSES IN PHYSICAL SYSTEMS. S. V. Dennovetskii and S. V. Svechnikov (Inst. for Semiconductors, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 1, 110-14(Jan.-Feb. 1964). (In Russian)

A method is described for investigating transient processes in physical systems. A functional transformer that enables the transformation of relaxation curves of systems into curves of transient relaxation time is presented. The method converts the periodic treatment to a single transitional process with instantaneous coordinates. Amplitude and time in the auxiliary circuit is transformed to specific relaxation speed and time. Transforming the functions

into new coordinates yields information about the time variation of single processes and represents them in the form of functional approximations describing the course of elementary relaxation processes. The transformer has a differentiator with a positive reciprocal relation, a pulse-time separator, and a memory device. (tr-auth)

20079 RADIOLYSIS OF 2,2,4-TRIMETHYLPENTANE WITH γ RAYS FROM ^{60}Co. Stelio Munari and Fiametta Cocchi (Università, Genoa). Ric. Sci., Rend., Sez. A, (2), 3: 1169-72(Dec. 1963). (In Italian)

Radiolysis of 2,2,4-trimethylpentane with γ rays of different intensities and different doses from ^{60}Co was studied for products in the range C_1 to C_8. Radiolysis products were identified with gas chromatographic techniques and mass spectrometry, and G data were calculated. Some of the products in the range C_9 to C_{16} were identified and the various G values were compared with the data obtained by others; in addition, the ratio isoctene (1) isoctene (2) was calculated. (auth)

20080 ON THE EFFECTS OF X RADIATION ON ALKALI NITRATE SOLUTIONS. Georg Geissler (Universität, Bonn). Strahlentherapie, 123: 451-6(March. 1964). (In German)

Irradiation of nitrate solutions with x rays as well as uv light produced nitrite ions, which can be determined with sulfanilic acid and with α-naphthylamine. In the case of ammonium nitrate solutions, however, the nitrite formation is almost proportional to the absorbed energy. NH_4NO_3 solutions can be used, therefore, in chemical radiation dosimetry. (auth)

20081 EXPERIMENTS ON PHOTOCHEMICAL AMINE FORMATION. Kurt Flemming (Heiligenberg-Institut, Ger. and Universität, Freiburg i. B.). Strahlentherapie, 123: 457-64(Mar. 1964). (In German)

It is shown that phenylalanine, tryptophan, and tyrosine in aqueous solutions are decarboxylized to phenylethylamine, tryptamine, and tyramine by uv-irradiation: therefore, production of dopamine in uv-irradiated dioxyphenylalanine solutions is considered probable. Therefore, not only vasodilating (histamine, serotonine) but also vasoconstrictor amines are produced by the photochemical amino acid decomposition. A substance in its effect similar to histamine is formed in addition to tyramine in uv-irradiated tyrosine solutions. Its chemical nature is unknown. The photochemical production of amines is increased by oxygen, reducing substances, and H_2O_2. It is assumed that it is caused not only directly by energy absorption but also indirectly by the influence of OH^- radicals. The radiobiological importance of the results is discussed. (auth)

20082 RADIATION CHEMISTRY AT THE "BORIS KIDRIC" NUCLEAR SCIENCE INSTITUTE AT VINCA. Ivan Draganić (Inst. for Nuclear Science "Boris Kidric," Belgrade). Tehnika (Belgrade), 18: 805-10(May 1963). (In Serbo-Croatian)

Activities in radiation chemistry and other developments at the Institute are described. (OID)

20083 DESIGN AND APPLICATIONS OF CALORIMETERS IN THE STUDY OF RADIATION CHEMISTRY OF AQUEOUS SOLUTIONS. Branislav Radak (Inst. for Nuclear Science "Boris Kidric," Belgrade). Tehnika (Belgrade), 18: 1221-4(July 1963). (In Serbo-Croatian)

A knowledge of G-values is necessary and the direct measurement of the absorbed radiation energy is very important in research on reaction mechanisms in radiation chemistry. A survey is presented of the present state of radiation chemistry calorimetry in Yugoslavia and abroad. Three calorimeters were chosen for work with aqueous solutions; 2 of them were developed at the "Boris Kidric" Inst. A description of the adiabatic apparatus, applications, and results are given for a calorimeter which measures directly the G-values in the field of γ radiations. The isothermal calorimeter (with thermistor) for use with mixed reactor radiations is described, and results of measurements in the reactor at Vinča are given. The principle of operation and a description are given for the differential calorimeter which makes direct chemical measurements of the G-values in the reactor field. Results of measurements in the reactor at Vinča and a comparison with other measurements are given. (auth)

20084 THERMAL STRESS BEHAVIOR OF RADIATION-INDUCED GRAFT POLYMERS OF COTTON. Jett C. Arthur, Jr., Anthony R. Markezich, and Wilbur F. McSherry (Southern Regional Research Lab., New Orleans). Textile Res. J., 33: 896-8(Nov. 1963).

Second-order transition temperatures of selected radio-induced graft polymers of fibrous cotton cellulose are presented, and the thermal stress behavior of the products is discussed. Graft polymers of cotton in the form of yarns were thermoplastic, probably due to lowered cohesive forces of the cellulose. Graft polymers of cotton-polystyrene showed a drop in resiliency index and stiffness with increasing temperature at about 100°C, while graft polymers of cotton-polyacrylonitrile and cyanoethylated cotton-polyacrylonitrile showed drops in resiliency index and stiffness at 80–100°C. On relaxation, the recovery of the energy expanded to elongate graft polymers of cotton to about 1.5% was about 40%, except for cyanoethylated cotton-polyacrylonitrile, where about 66% recovery was observed. (P.C.H.)

20085 THE APPLICATION OF SOLVENT EXTRACTION IN RADIOCHEMISTRY. Ignacy Stronski (Inst. of Nuclear Physics, Krakow). Wiadomosci Chem., 18: 19-46(1964). (In Polish)

Advances in the application of the partition method to separation and purification procedures in liquid–liquid systems are described. Investigations of the physical chemistry of extraction processes by the tracer method were characterized. 190 references are included. (auth)

20086 DETECTION OF FREE RADICALS IN FATS IRRADIATED WITH γ-RAYS BY MEANS OF ELECTRON SPIN RESONANCE SPECTROSCOPY. H. Lueck, U. Deffner, and R. Kohn (Technische Hochschule, Munich). Z. Lebensm. Untersuch. Forsch., 123: 200-5(Oct. 1963). (In German)

Electron spin resonance (ESR) spectroscopy offers a convenient method for determining the occurrence of free radicals in food products irradiated with γ rays. Some work has been done on meat and vegetables, but nothing on fats. For this reason, lard, tallow, and cocoa butter were irradiated at –196, –80, 0, and +30°C with 1, 2, and 10 Mrad γ rays at a rate of 0.5 Mrad/hr and measured the ESR spectra at –196, –80°C, and at room temperature allowing various times to elapse between irradiation and measurement. The spectra were taken with a Varian V 4500 spectrometer at a modulation of 100 kHz. In all the examined fats, free radicals were found after irradiation with high doses at very low temperatures. The number of free radicals was very small and their life duration varied at room temperature between fractions of a minute and several weeks. The spectra of the fats investigated were very similar, although their life duration varied depending on the presence of impurities which acted as radical scavengers. When the irradiated fats were stored for some time

at room temperature, free peroxide radicals were found. (OID)

20087 THE GAMMA RADIOLYSIS OF CARBON MONOXIDE IN THE PRESENCE OF RARE GASES. S. Dondes, P. Harteck, and H. von Weyssenhoff (Rensselaer Polytechnic Inst., Troy, N. Y.). Z. Naturforsch., 19a: 13-18 (Jan. 1964).

The gamma radiolysis of carbon monoxide in the presence of the rare gases (Ar, Kr, and Xe) was studied with and without the application of an electric field. The results showed that energy transfer producing excited species is the important phenomenon. Specifically, excited CO molecules react with other CO molecules producing carbon dioxide and carbon suboxide polymer. (auth)

20088 RADIOCHEMICAL CYCLODIMERIZATION OF 1,3-CYCLOHEXADIENE AND NEW METHODS OF FORMATION FOR DIELS-ALDER ADDUCT. A REPORT ON THE REACTION MECHANISM OF THE DIELS-ALDER REACTION. G. O. Schenck, S.-P. Mannsfeld, G. Schromburg, and C. H. Krauch (Max-Planck-Institut für Kohlenforschung, Mulheim-Ruhr, Ger.). Z. Naturforsch., 19b: 18-22(Jan. 1964). (In German)

The radiochemical cyclodimerization of 1,3-dienes can lead to syn- and anti-C_4-cycloadducts of the Diels-Alder type. The previously unknown exo-Diels-Alder dimer (V) of 1,3-cyclohexadiene was obtained by gamma irradiation of 1,3-cyclohexadiene in benzene and by irradiation in sensitized and unsensitized photoreactions. The same product was obtained as with thermal cyclodimerization and ring isomerization. Diels-Alder adducts could be formed radiochemically by different chemical relay mechanisms, which require the participation at times of at least 3 molecules. For the pure thermal uncatalyzed Diels-Alder dimerism of 1,3-cyclohexadiene the trimolecular substrate relay mechanism is discussed. (tr-auth)

20089 IRRADIATION — PROPERTIES CHANGES. Vincent L. Lanza (Raychem Corp., Redwood City, Calif.). p.301-60 of "Crystalline Olefin Polymers. Part II." New York, Interscience Publishers, 1964.

A review is presented on the effects of irradiation on the mechanical, chemical, physical, and electrical properties of polymers, and the effects of temperature, crystallinity, atmosphere, additives, dose rate, and molecular weight on radiation effects on polymers. Post irradiation effects, irradiation grafting, elastic memory, and technology of irradiation are also discussed. 95 references are included. (P.C.H.)

20090 THE EFFECT OF IONIZING RADIATION ON RIBOFLAVINE. P. Guldner. Thesis, Bern, Universität, 1960. 29p. $2.00(Gmelin, AED-DISS. 60-9). (In German)

Aqueous solutions of riboflavin were irradiated with 250-kv and 31-Mev x rays and with 30-Mev electrons. Partial disintegration of the riboflavin molecules with 100 r was observed. Disintegration is proportional to doses up to 2000 r. The effect was the same for all 3 types of radiation. Because the disintegration of riboflavin is a multistage process, a time factor was observed. The disintegration mechanism was investigated by means of paper chromatography. Two disintegration products, which are not produced by light, were isolated. (Gmelin Inst.)

20091 THE REACTION OF WHITE P WITH CCl_4 UNDER THE INFLUENCE OF γ-RAYS AND NEUTRONS AND THE EXCHANGE OF P ATOMS BETWEEN P AND PCl_3. D. Perner. Thesis, Berlin, Universität, 1963. 78p. $2.00(Gmelin, AED-DISS. 63-320). (In German)

Reaction products of the reaction of white P with CCl_4 under the influence of light, heat, and γ-rays are given. For room temperature the main product is red P. G values for these reactions are tabulated. Possible mechanisms are discussed. See also NP-13234. (Gmelin Inst.)

20092 CARBON^{14}-CONTAINING COMPOUNDS PRODUCED BY THE PILE NEUTRON IRRADIATION OF SOME CRYSTALLINE AMIDES AND AMIDINES. Thomas William Lapp. Thesis, Manhattan, Kan., Kansas State Univ., 1963. 105p.

Chemical effects produced by the $^{14}N(n,p)^{14}C$ nuclear transformation in a series of five crystalline nitrogen-containing organic molecules were investigated in an attempt to obtain a more complete understanding of the chemical processes occurring during the recombination of the recoil atom into stable chemical species. The results of similar studies with crystalline inorganic compounds showed that the activity isolated was entirely in the form of simple molecules, containing only one or two carbon atoms. Investigations into the percentages of the total activity found to be present in the form of simple molecules upon neutron irradiation of a number of crystalline amides and amidines are also reported. The compounds selected for the study were guanidine hydrochloride, urea, acetamide, acetamidine hydrochloride, and α-cyanoacetamide. Reaction mechanisms are proposed for the formation of those species containing appreciable quantities of the total activity isolated in each of the compounds investigated. Interpretation of the observed results was made in terms of the Seitz-Koehler displacement spike model for the interaction of radiation with crystalline materials. In each of the compounds investigated, the recoil atom is proposed to undergo replacement reactions with the parent molecule in, or immediately adjacent to, the displacement spike. The replacement reaction apparently results in the rupture of one or two bonds in the parent molecule with the formation of a large molecular fragment containing the recoil carbon-14 atom, but not the rupture of bonds within the parent molecule to produce small fragments containing the recoil atom. The associated gamma radiation accompanying the neutron flux was viewed as possibly playing an appreciable role in the formation of some of the molecular fragments proposed to occur in the displacement spike. However, the two effects are indistinguishable. The results showed that in two of the compounds, guanidine hydrochloride and urea, parallel reaction mechanisms may be proposed and that the results may be readily correlated with those obtained in a previous investigation of a related compound, cyanoguanidine. In all of the molecules investigated, the formation of appreciable percentages of the total activity was found to be absent in the simpler compounds, containing one or two carbon atoms. These results are in direct opposition to the previously reported investigations of the neutron irradiation of inorganic compounds in the solid state. The explanations given above, consistent with the experimental results, were advanced to explain these differences and lead to an improved understanding of the hot-atom and radiation chemistry of solid, covalently-bonded, nitrogen-containing compounds. (Dissertation Abstr., 24: No. 9, March 1964)

20093 THE RADIOLYSIS OF CYCLOPENTANONE AND MIXTURES CONTAINING CYCLOPENTANONE. Meiseki Katayama. Thesis, Newark, Del., Univ. of Delaware, 1963. 144p.

The radiation-induced decomposition of cyclopentanone was studied in the liquid and gas phase using ^{60}Co γ rays. The main reaction products were carbon monoxide, ethylene, H, and an oil. The initial G-values for carbon monox-

ide and ethylene were ~1.5 and 0.3, respectively. At an absorbed dose of $\sim 10^{20}$ ev (3 to 10 hrs irradiation), G(CO) was ~0.8 and $G(C_2H_4)$, 0.7. The G-value for H was 0.68 and stayed constant up to 24 hrs irradiation. Among the minor products identified were cyclobutane, butene-1, n-butane, and carbon dioxide. The carbon monoxide, ethylene, and H constituted more than 90% of the gaseous products. The G-value for production of the oil was estimated to be ~1 using a molecular weight of 200. The experimental formula for this material was best represented by (C_6H_9O). A mechanism for the radiolysis of cyclopentanone is proposed. The concentration effects of the radiolysis on the major gaseous products were examined in cyclohexane, cyclohexene, and benzene solutions of cyclopentanone. Some comparisons were made between radiolysis and photolysis of cyclopentanone. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20094 Co^{60} GAMMA IRRADIATION OF SOLID SOLUTION PROPIONAMIDE–ACRYLAMIDE SYSTEM. Rajiengar Ranganathan. Thesis, New York, New York Univ., 1963. 85p.

The chemical effects induced by ^{60}Co γ irradiation of solid solutions of propionamide and acrylamide were investigated. The effects of energy input, composition, and temperature on the radiolytic products of the organic solids irradiated singly and in solid solutions were studied. The gases collected at –196°C from irradiated (22°C) propionamide are H (G_{H_2} = 0.44), carbon monoxide (G_{CO} = 0.10), and smaller amounts of methane (G_{CH_4} = 0.012). Under the same conditions acrylamide gives mostly H, although in amounts much smaller (G_{H_2} = 0.047). Polyacrylamide isolated from the monomer has a G value for H formation equal to 0.24. Analysis of H_2, HD, and D_2 yields from irradiation of samples containing propionamide-d_7 shows that the H is formed exclusively through a bimolecular process involving H atoms. From the runs made at different temperatures "hot" H atoms seem to participate in these reactions. Gamma-ray-initiated solid-state polymerization of acrylamide is of great significance in judging the nature of the composition of the system during radiolysis. Product yields vary with the composition of the system in a way not in keeping with the mixture rule. While the variation in the yields of H is explained as a consequence of scavenging action or energy transfer processes, the yields of methane and carbon monoxide appear to be strongly influenced by such factors as formation of unoriented amorphous polyacrylamide, recrystallization, and propagation of radicals in the solid matrix. A brief note on the EPR spectra of the irradiated samples is included. Some observations are made on the γ irradiation of solid solutions of anthracene and acridine. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20095 FORMATION OF OZONE FROM OXYGEN BY THE ACTION OF IONIZING RADIATIONS. G. R. A. Johnson and J. M. Warman (Univ. of Newcastle-upon Tyne, Eng.). 10p. (CONF-462-1)

From The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

The formation of O_3 from O_2 and from rare gas + O_2 and N_2 + O_2 mixtures was investigated. The results are interpreted in terms of the primary, radiation-produced, excited, and ionic species. Some possible applications of the conclusions reached to an understanding of the chemistry of the upper atmosphere are considered. (auth)

20096 PRODUCTION OF GRAFT COPOLYMERS. Jean Durup and Michel Magat (to Centre National de la Recherche Scientifique). U. S. Patent 3,131,138. Apr. 28, 1964. Priority date Aug. 28, 1958, France.

A process is given for the production of graft copolymers from polystyrene and other polymers which do not readily produce active centers upon irradiation in the presence of oxygen. The process comprises carrying out the irradiation in the presence of both oxygen and a material capable of producing a high yield of free radicals without undergoing chain oxidation, and contacting the irradiated polymer with a monomer to produce a graft copolymer. The material is a solvent for the polymer, preferably CCl_4 or other perhalogenated alkanes. The best peroxide yields are obtained with relatively high polymer concentrations, with an optimum of 50 g/l polystyrene. Three examples of the process are given in which acrylonitrile and methyl methacrylate were polymerized onto polystyrene. (D.L.C.)

Separation Processes and Procedures

20097 (CONF-179-1) ION EXCHANGE ABSORPTION OF CESIUM BY POTASSIUM HEXACYANOCOBALT(II) FERRATE(II). W. E. Prout, E. R. Russell, and H. J. Groh (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 23, 1963. Contract AT(07-2)-1. 14p.

From the American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964.

A description is given of the preparation and properties of a granular form of potassium hexacyanocobalt(II) ferrate(II) that is a highly selective absorbent for cesium ion. The material is suitable for use in a large-scale ion exchange column, and offers the possibility of isolating and concentrating ^{137}Cs from the fission product waste solutions which arise from the processing of nuclear fuels. (auth)

20098 (IS-780) SOLVENT EXTRACTION STUDY OF THE SYSTEM MONAZITE RARE EARTH NITRATES–NITRIC ACID–WATER–TRIBUTYL PHOSPHATE. Brooks Martin Sharp and Morton Smutz (Ames Lab., Ames, Iowa). Nov. 1963. Contract W-7405-eng-82. 157p.

Using single stage equilibrium data for the systems shown below, plus the assumption of mutual immiscibility of water and tributyl phosphate (TBP), a calculation method was developed to give the stagewise conditions in a cascade of equilibrium stages with all species present in the flow streams.

$La(NO_3)_3 - HNO_3 - TBP - H_2O$
$Pr(NO_3)_3 - HNO_3 - TBP - H_2O$
$Nd(NO_3)_3 - HNO_3 - TBP - H_2O$
$Sm(NO_3)_3 - HNO_3 - TBP - H_2O$
$La(NO_3)_3 - Pr(NO_3)_3 - HNO_3 - TBP - H_2O$
$Nd(NO_3)_3 - Pr(NO_3)_3 - HNO_3 - TBP - H_2O$
$Sm(NO_3)_3 - Pr(NO_3)_3 - HNO_3 - TBP - H_2O$

The calculation method was checked via a series of simulated column experiments. The agreement between predicted and experimental stagewise conditions was considered reasonable, and the calculation is considered useful for engineering work. As the calculation is tedious and time consuming, digital computer programs were written for the IBM 7074 to calculate the stagewise conditions in cascades of interest. It is hoped these programs will be useful in design and optimization studies. (auth)

20099 (LA-3029) LARGE SCALE ELECTROREFINING OF PLUTONIUM FROM PLUTONIUM–IRON AL-

LOYS. L. J. Mullins, J. A. Leary, and A. N. Morgan (Los Alamos Scientific Lab., N. Mex.). Oct. 10, 1963. Contract W-7405-eng-36. 35p.

Electrorefining processes have been developed for the recovery of plutonium from plutonium–iron alloys on the 3.5 kg scale. The process can be controlled to produce plutonium metal containing <35 ppm of iron and a total of <100 ppm of detectable metallic impurities. With an alloy initially containing 2.50 wt.% iron, the recovery yield is ~82%. The theory of plutonium alloy electrorefining is discussed, and a method based on back emf measurements for controlling the process automatically is presented. (auth)

20100 (ORNL-3524) PROPERTIES AND CLEANUP OF DEGRADED TRIBUTYL PHOSPHATE–AMSCO SOLUTIONS AND THE RELATIVE STABILITIES OF ALTERNATIVE EXTRACTANT-DILUENT SYSTEMS. C. A. Blake, Jr., W. Davis, Jr., and J. M. Schmitt (Oak Ridge National Lab., Tenn.). Dec. 11, 1963. Contract W-7405-eng-26. 37p. (CONF-491-1)

From Solvent Extraction Chemistry Symposium, Gatlinburg, Tenn., Oct. 1962.

The formation and chemical properties of the major degradation products of several diluents in contact with acid nitrate solutions have been studied, together with (1) methods for purifying degraded diluents, (2) methods of pretreating the diluent to minimize degradation, and (3) the relative stability of several extractant-diluent systems. Emphasis was on Amsco 125-82, a specially treated naphtha used extensively at ORNL as a diluent for tributyl phosphate, a prominent extractant in liquid-liquid extraction systems used to recover uranium from aqueous solutions containing many elements. Accelerated degradation of the diluent, usually containing 1 M tributyl phosphate (TBP), was induced by boiling with nitric acid or by irradiating (^{60}Co gamma rays) while agitating the solvent phase with nitric acid. Nitroparaffins, RNO_2, were the major degradation products and were formed at twice the rate when TBP was present during degradation. Under the conditions of degradation, a 100-whr/liter exposure was practically equivalent to 11 hr of boiling with 2 M HNO_3, as shown by Zr-Nb^{95} extraction, total organic nitrogen analysis, and spectrophotometric analysis. Extraction from acid solution of certain fission products, for example, Zr-Nb but not ruthenium, increased markedly after the degraded solvent had been treated with alkaline reagents, and a test employing solid calcium hydroxide was developed to estimate the extent of diluent degradation. The alkaline treatment converted a significant fraction of the nitroparaffin to the enol form. There was synergistic extraction of Zr-Nb^{95} by the combination of TBP and degraded diluent. The degraded diluents can be cleaned up by scrubbing with alkanolamines to remove nitroparaffin-amine salts or by contacting with activated alumina. Both methods have doubtful economy, and the latter requires solids handling. Low-pressure flash distillation is an effective, inexpensive method for partial or total repurification of degraded TBP-Amsco mixtures. Pretreating Amsco 125-82 by scrubbing with concentrated sulfuric acid before degrading with hot nitric acid improved its stability. The stabilities of a number of alternative aliphatic and aromatic diluents were determined. With aliphatic diluents, the configuration most stable against nitration is the simplest, for example, n-dodecane. Aromatic diluents increase the radiation stability and extraction selectivity or TBP. The stabilities of the simple alkylbenzenes against nitration vary widely with the number of alkyl groups, their type and their position, but a mixture of diethylbenzenes low in the para isomer, and some of the polymethylbenzenes, did not form fission product extractants in routine tests. Also, nitration of the benzene ring does not produce extractants for Zr-Nb^{95}. (auth)

20101 (UCRL-11300) NEUTRON AND ALPHA COUNTERS FOR HEAVY-ELEMENT COLUMN CHEMISTRY. Robert J. Walker, Tommy R. Corbin, and James T. Haley (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 18, 1964. Contract W-7405-eng-48. 8p.

Detectors were needed which could function in the presence of intense radiation backgrounds in the separation of transplutonium elements. Surface-barrier solid-state detectors were developed which fulfilled this need; with a removable Mylar window, a detector functions as an alpha counter, while with a polyethyene converter foil, it becomes a fast neutron counter with a unidirectional sensitivity. Some qualitative results obtained with Cf, Fm, and Es are given. (D.L.C.)

20102 (UJV-850/63) ISOLATION OF LONG-LIVING FISSION PRODUCTS FROM RADIOACTIVE WASTES. I. GROUP SEPARATION OF MIXTURE OF FISSION PRODUCTS. J. Krtil, Z. Kolařík, and V. Kouřím (Československá Akademie Věd. Ústav Jaderného Výzhumu, Rež). [1962]. 28p.

An investigation was made of sorption on ferric hydroxide as a method of separating fission product mixtures containing Fe, Al, and U. Precipitation of hydroxides was carried out at either medium or low pH, and Sr, Y, and/or Ce were then desorbed from the precipitate. The separations were satisfactory. (D.L.C.)

20103 EXTRACTION. George H. Morrison (Cornell Univ., Ithaca, N. Y.) and Henry Freiser. Anal. Chem., 36: 93R-116R(Apr. 1964).

A review is presented on solvent extraction processes. The process of extraction, extraction systems, apparatus and techniques, and procedures are discussed. Extraction procedures for the various elements are tabulated. 956 references are included for the period late 1961 to late 1963. (P.C.H.)

20104 SEPARATION OF RARE EARTHS FROM OTHER METAL IONS BY ANION EXCHANGE. James S. Fritz and Richard G. Greene (Iowa State Univ., Ames). Anal. Chem., 36: 1095-7(May 1964). (IS-814)

Elements of the rare earth group are retained by a nitrate-form anion exchange column from dilute nitric acid solutions in water-isopropyl alcohol. Elution with 1.5M nitric acid in 85% isopropyl alcohol allows many less sorbable elements to be separated from the rare earths. The higher rare earths can be eluted from the column using lower percentages of isopropyl alcohol and separated from bismuth(III), lead(II), and thorium(IV), which remain on the column. (auth)

20105 THE CONCENTRATION OF ^{231}Pa FROM URANIUM PROCESSING WASTES. Vikt. I. Spitsyn, and R. A. D'yachkova. At. Energ. (USSR), 16: 134-7(Feb. 1964). (In Russian)

The carrying of trace amounts of ^{231}Pa on phosphoric acid resins, MnO_2, SnO_2, Al_2O_3, Sb_2O_3, and Cr_2O_3 was determined in 0.1, 0.25, 0.5, 1, 2, and 3N HNO_3. MnO_2 (10 mg/ml) was found to be the best carrier for ^{231}Pa, even in the presence of large amounts of extraneous salts such as iron (30 g/l), Al (15 g/l), Ca (35 g/l), and Mg (6 g/l). The amount of iron, Al, or Cu carried down with the MnO_2 carrier rapidly decreased with increasing acidity. It is recommended that ^{231}Pa be carried on MnO_2 from a >1N HNO_3

solution. A sharp separation of ^{231}Pa from manganese can be carried out by extracting the ^{231}Pa into β-β'-dichlorodiethyl ether from a 9.0N HCl solution. The manganese remains in the aqueous phase. Tributylphosphate (TBP) also extracts ^{231}Pa quantitatively from a 2 to 9N HNO_3 solution. A total of 98.4% ^{231}Pa is carried by a precipitate of zirconium salicylate, while only 4.5% of the titanium is carried down under these conditions (2.5N H_2SO_4 + 1% H_2O_2). The salicylate method was the most suitable for separating Zr from Ti. (TTT)

20106 SOLVENT EXTRACTION SEPARATION OF THORIUM FROM RARE EARTHS WITH ACETYL ACETONE. Ken-ichi Tsutsumi (Mitsui Mining and Smelting Co., Ltd., Tokyo). Bunseki Kagaku, 13: 231-5(Mar. 1964). (In Japanese)

A solvent extraction separation of thorium from rare earths in the system of acetyl acetone complex-carbon tetrachloride is presented. The extraction of thorium is essentially complete at higher pH than 4.5, whereas the complexes of some light rare earths such as lanthanum, cerium(III), praseodymium, neodymium, and samarium and yttrium are not at all extracted within the pH range 1 ~ 8. The non-extraction of heavy rare earths is also expected to be essentially the same as that found in the light rare earths, and the optimum pH range of 4.5 ~ 6 for the extraction separation of thorium was adopted. The method in which synthetic mixtures containing thorium and light rare earths can be separated by an established practical technique was examined and excellent results were obtained. The proposed method is recommended for the separation of thorium from rare earths. The depolarimetry of thorium oxinate with potassium bromate and the potentiometry of cerium(IV) with potassium ferrocyanide were also investigated, in conjunction with the standardizations of thorium and cerium stock solutions, with sufficiently acceptable results. (auth)

20107 THE INFLUENCE OF NITRATES ON THE EXTRACTION OF NITRIC ACID BY LONG-CHAIN ALYPHATIC AMINES. F. Baroncelli, G. Scibona, and M. Zifferero (CNEN, Rome). Energia Nucl. (Milan), 11: 129-33(Mar. 1964).

The influence of different metal nitrates such as $Al(NO_3)_3$, $Ca(NO_3)_2$, $LiNO_3$, and $UO_2(NO_3)_2$ on the extraction of nitric acid from aqueous solution by long-chain amines is discussed. Two cases were considered separately: the extraction from aqueous solutions containing a non-extractable nitrate such as aluminum, calcium, or lithium nitrate; and the extraction from aqueous solutions containing an extractable nitrate such as uranyl nitrate. (auth)

20108 ON THE SEPARATION OF RARE EARTHS. XI. SOLUBILITIES OF BINARY AND TERNARY SYSTEMS CONTAINING THE NITRATES OF CERIC EARTHS. G. Brunisholz, J. P. Quinche, and Abdel Magid Kalo (Université, Lausanne, Switzerland). Helv. Chim. Acta, 47: 14-26(1964). (In French)

The solubility polytherms of the binary systems $R(NO_3)_3$–H_2O (R = La, Ce, Pr, Nd, and Sm) were established between 0 and 50°C. The nitrate hexahydrates of lanthanum and cerium were not isotypic with the corresponding salts of the other members of the rare earth group. This fact was responsible for the solubility anomaly discovered by Quill and Robey ($Ce(NO_3)_3,6H_2O$ is the most soluble salt of the series) and for the miscibility gap occurring in the solid phases of the systems comprising the two types of the rare earth nitrate hexahydrates. Five ternary systems were investigated at various temperatures, using a technique that yields homogeneous mixed crystals. (auth)

20109 CHARACTERISTICS OF BIS(2-ETHYLHEXYL) ORTHOPHOSPHORIC ACID CHROMATOGRAPHIC COLUMN FOR RARE-EARTH SEPARATION. Hwa-Sheng Cheng, Chiung-Huei Ke, Ching-Yu Lin, and John W. Winchester (National Tsing Hua Univ., Hsinchu, Taiwan, China). J. Chinese Chem. Soc. (Taiwan), 10: 80-5(Sept. 1963).

Separation factors for La, Ce, and Pr were measured precisely on columns of bis(2-ethylhexyl) orthophosphoric acid (DEP) supported on diatomaceous silica made hydrophobic with dimethyldichlorosilane. Column behavior is related to the properties of DEP when used as a solvent extractant, and the column method is a useful one for studying a solvent extraction system with great precision and reproducibility. Separation factors measured are Ce/La = 2.8 ± 0.1 and Pr/Ce = 2.7 ± 0.1. The dependence of elution volume on HCl activity was found to be approximately 2.5 power in the range 0.2–0.3 M HCl. (auth)

20110 SEPARATION OF RARE EARTHS ON ANION EXCHANGE RESINS. IV. INFLUENCE OF TEMPERATURE ON ANION EXCHANGE BEHAVIOUR OF THE RARE EARTH ETHYLENEDIAMINETETRAACETATES. Rajmund Dybczyński (Inst. of Nuclear Research, Warsaw). J. Chromatog., 14: 79-96(Mar. 1964).

The influence of temperature on the anion exchange behavior of rare earth elements in the system: Amberlite IRA-400 [H_2Y^{2-}]-aq solution of disodium ethylenediaminetetraacetate (Na_2H_2Y) was investigated. In the system examined the change of temperature has a double effect: the height equivalent to a theoretical plate decreases with a rise of temperature; and the distribution coefficients of the individual ions undergo changes according to the enthalpy values of the ion exchange reactions. As the enthalpies of the ion exchange reactions differ in magnitude and sign for different rare earths, the separation factors (ratio of distribution coefficients) may undergo considerable changes with a change of temperature. Both effects contribute to the final resolution value; for some elements the order of elution is even reversed. New possibilities in qualitative analysis, resulting from the determination of the selectivity coefficient of an exchange reaction for a given ion at different temperatures, are pointed out. (auth)

20111 OXIDATIVE DECLADDING OF URANIUM DIOXIDE FUELS. J. E. Bodine, I. J. Groce, J. Guon, and L. A. Hanson (Atomics International, Canoga Park, Calif.). Nucl. Sci. Eng., 19: 1-7(May 1964).

The oxidative decladding of UO_2 fuels was demonstrated on three-foot sections of unirradiated fuel rods and on eight-inch sections of fuel rods irradiated to 21,000 Mwd/MTU. Decladding rates were unaffected by the extent of irradiation. Uranium dioxide that was unirradiated, irradiated, and with fissia added to simulate 100,000 Mwd/MTU irradiation was declad at similar rates. The effect of pressure and temperature on decladding rates was determined. Puncturing the cladding greatly enhanced the rate and gave a coarser product. This product was not completely converted to U_3O_8 during oxidative decladding. Greater than 99.9% of the UO_2 fuel was removed from the cladding. There was no detectable contamination of the product by the cladding material. Little or no fission-product or plutonium decontamination was observed. Dissolution rates for the declad product, in 50% nitric acid, were 20 times as fast as for the "as received" UO_2 fuel. (auth)

20112 ON THE QUESTION OF MASS EFFECT IN THE ION MIGRATION IN SOLUTIONS (AFTER AN EXPERIMENT ON THE COUNTERCURRENT ELECTROLYTIC SEPARA-

TION OF YTTRIUM FROM DYSPROSIUM). H. Martin and H.-J. Luebke (Universität, Kiel). Z. Naturforsch., 19a: 115-26(Jan. 1964). (In German)

The separation of the rare earths Y and Dy with almost corresponding ion radii by countercurrent ion migration led to cathodic enrichment not of the light yttrium (atomic weight 88.9) but of the heavy dysprosium (atomic weight 162.5). A countercurrent electrolytic separation experiment, for which a dilute aqueous solution of YBr_3-$DyBr_3$ mixture containing terbium bromide was used as the electrolytic liquid, gave the individual separation factors interpretable as mobility ratios $W_Y/W_{Dy} = 0.9930$ and $W_Y/W_{Tb} = 0.9889$. The results can, on the basis of Lenard's gas kinetic theory of ion migration, which was proved valid for isotope mixtures, be understood qualitatively and quantitatively as mixed radius and mass effects. The possibility of determining solvation numbers from isotope effects of ion migration is discussed. (tr-auth)

20113 ANION-EXCHANGE BEHAVIOR OF SCANDIUM IN CHLORIDE-THIOCYANATE MEDIA. Hiroshi Hamaguchi, Naoki Onuma, Masanori Kishi, and Rokuro Kuroda (Tokyo Kyoiku Univ.). Talanta, 11: 495-500(Mar. 1964).

A method is described for the separation of scandium from rare earths and thorium by anion exchange. The method utilizes the adsorption of a negatively charged thiocyanato complex of scandium on the strongly basic anion exchanger Dowex 1-X8 from a 2M solution of ammonium thiocyanate in 0.5M hydrochloric acid. Rare earth elements are not retained on the column, while scandium and thorium show moderate adsorptions and can be separated chromatographically by elution with 3M hydrochloric acid. The distribution coefficient data for elements in this medium suggest many possible analytical separations of scandium. (auth)

20114 ANION-EXCHANGE BEHAVIOUR OF URANIUM AND OTHER ELEMENTS IN THE PRESENCE OF ALIPHATIC DI- AND TRICARBOXYLIC ACIDS. METHOD FOR THE SEPARATION OF URANIUM FROM THORIUM AND RARE EARTHS. J. Korkisch and I. Hazan (Universitat, Vienna). Talanta, 11: 523-30(Mar. 1964).

The exchange behavior of uranium, thorium, the rare earths and some other elements towards the strongly basic anion exchanger Dowex 1 in aqueous and methanolic systems containing di- or tricarboxylic acids is described. Based on the measurement of the distribution coefficients in such media a method for the separation of uranium from thorium and the rare earths in an aqueous solution containing malonic acid was developed. (auth)

20115 THE ELECTROLYTIC DISSOLUTION OF NUCLEAR FUEL ELEMENTS. G. R. Hall (Imperial Coll. of Science and Tech., London) and D. H. Logsdail. Trans. Inst. Chem. Engrs. (London), 41: 336-41(Dec. 1963).

Recent developments in the fabrication of nuclear fuels have led to the use of materials that are difficult or impossible to dissolve in nitric acid. To devise methods to overcome this difficulty, investigations were carried out on the application of two methods in which the fuel (and cladding) form the anode in an electrolytic cell. In one, the multi-cell tubular dissolver, current is conveyed to a randomly-packed bed of small cylinders of uranium through a cylindrical tantalum electrode in contact with one end of the bed; in the other, the anode basket dissolver, small cylinders of stainless steel or 50v/v stainless steel-uranium dioxide cermet are contained in an anodic tantalum basket that is surrounded by a tubular stainless steel cathode. The electrical characteristics and operation of both dissolvers are discussed. Each offers advantages over present direct acid chemical dissolvers, particularly for highly enriched fuels. (auth)

20116 REPROCESSING OF BeO BASED FUELS. R. C. Cairns (Australian Atomic Energy Commission). 26p. (CONF-281-42)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The problems of reprocessing ceramic dispersion fuels based on BeO are reviewed. The need for reprocessing is outlined in terms of the costs of replacing the raw materials and strategic considerations. The types of BeO fuels under study for planned reactor systems are given with emphasis on the type being considered in the Australian High Temperature Gas Cooled Reactor study. The processing methods available for treating the fuels are reviewed and a description is given of the approach adopted to develop a suitable process for the Australian concept. The problems created in the head-end steps, and primary separation step, owing to the presence of beryllium, are discussed as well as the problem of recovering beryllium oxide. The fuel cycle problems due to ^{235}U build up for fuels of long life based on thorium are briefly discussed. The need to obtain reliable cost estimates for the fuel cycle of the reactor system is emphasized and the cost study philosophy based on a single reactor installation is explained. It was concluded that because of the high cost of beryllium oxide and the additional difficulties it causes in the fuel cycle it is desirable to keep as little beryllium oxide mixed with the fuel as possible. (auth)

20117 PROCESS FOR PRODUCTION OF HIGH PURITY CESIUM METAL AND CESIUM COMPOUNDS. Robert J. Moolenaar and Paul R. Juckniess (to Dow Chemical Co.). U. S. Patent 3,130,010. Apr. 21, 1964. Filed Dec. 4, 1962.

An improved method is given for the direct production of high-purity Cs, Cs hydroxide, and other Cs compounds from the hydroxide. The method comprises reacting pollucite ore in an inert gas atmosphere with Li, K, or Na reductant at a temperature below the vaporization temperature of the reductant to distil off impure Cs, redistilling the Cs, forming a Cs amalgam, and hydrolyzing the amalgam to form Cs hydroxide which may then be converted into other Cs compounds by reaction with acid. Examples of the method and the purities obtained are given. (D.L.C.)

20118 PROCESSING THORIUM–BISMUTH AND THORIUM–LEAD COMPOUNDS. Robert J. Teitel (to Dow Chemical Co.). U. S. Patent 3,130,042. Apr. 21, 1964. Filed Aug. 2, 1961.

A method for recovering entrapped U from solid Th–Bi or Th–Pb intermetallic compounds is described which does not require temperatures as high as 1000°C and which can be carried out remotely. The method comprises dispersing the intermetallic compound in liquid Bi and/or Pb, changing the temperature and/or liquid metal composition to convert the intermetallic compound into another intermetallic compound, and separating the U-containing liquid phase from the solid phase. The method is discussed with reference to the Bi–Pb–Th phase diagram. An example of the method is given in which ^{233}U was separated from irradiated $ThBi_2$. (D.L.C.)

ENGINEERING

General

20119 (ARL-64-5) RESEARCH IN HYPERSONICS AND MAGNETOHYDRODYNAMICS. Z. S. Chang, R. E. Duffy, R. F. Hoppmann, D. F. Rogers, T. R. Sundaram, and H. S. Glick (Rensselaer Polytechnic Inst., Troy, N. Y.). Oct. 1963. Contract 33(616)-7312. 136p.

The hypersonic shock tunnel and the calibration shock tube are described, and their performance is discussed. The nonequilibrium character of expanding flows, hypersonic flow of low-density gas over cone models, and the electrical conductivity between electrodes in a moving plasma were studied experimentally. Nonequilibrium inviscid flows were also investigated theoretically. The studies are discussed in detail. (D.C.W.)

20120 IMPACT OF NUCLEAR TECHNOLOGY ON HIGHWAY ENGINEERING. Percy L. Blackwell (Bureau of Public Roads, Washington, D. C.). 12p. (CONF-433-2)

From American Society for Testing Materials 1964 International Conference on Materials, Philadelphia, Feb. 1963.

Nuclear methods of testing, measuring, and evaluating materials for the construction and maintenance of highways are discussed. Methods for material layer moisture content and density analyses, thickness gages, tracer techniques for wear determination, nondestructive testing methods, radioisotopes for self-luminous highway signs, the use of nuclear explosives, radiography, and laser cutting and welding techniques are considered. (C.E.S.)

Applications of Nuclear Explosions

20121 (CONF-470-1) ISOTOPE RECOVERY FROM A NUCLEAR DETONATION IN SALT. D. G. Karraker (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Feb. 25, 1964]. Contract AT(07-2)-1. 18p.

From 3rd Plowshare Symposium on Engineering With Nuclear Explosives, Davis, Calif., Apr. 1964.

The production of isotopes by the detonation of a nuclear device involves recovery of the debris from a contained explosion, and separation of the products from the shot debris by chemical processing. The choice of a salt formation for explosion of the device is extremely favorable for chemical processing, since the solubility of salt in water affords a natural beginning for recovery in an aqueous system. The major problem of chemical processing is the separation of a few ppb of product isotopes from the mass of salt and other minerals present in the shot debris. A simple model of the nuclear production process and data from the debris of the "Gnome" experiment indicates that the product isotopes are associated in the debris with minerals of roughly the same volatility; thus a "carrier" mineral retains most product isotopes and permits the removal of the salt by water leaching without significant loss of most products. The product isotopes are concentrated and recovered by chemical processing of the "carrier." Processing methods that can be applied to the recovery of isotopes of the alkali, alkaline earth, rare earth, actinide, and transition metals are outlined. (auth)

20122 (UCRL-7711) CONTAINED NUCLEAR DETONATIONS IN FOUR MEDIA-GEOLOGICAL FACTORS IN CAVITY AND CHIMNEY FORMATION. Charles R. Boardman, David D. Rabb, and Richard D. McArthur (California. Univ., Livermore. Lawrence Radiation Lab.). [Feb. 4, 1964]. Contract W-7405-eng-48. 30p. (CONF-470-2)

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

Underground nuclear tests in tuff, alluvium, rock salt, and granite have yielded data essential to the evaluation of the effects of contained nuclear detonations. The data indicate that for these mediums the cavity radius is predictable within ±20% without regard to the physical or chemical properties of the rock in the immediate shot environment. Properties of the chimney of broken rock resulting from collapse of the cavity, on the other hand, were found to be related to the physical properties of the rock and to preshot structural weaknesses within the rock. (auth)

20123 (UCRL-7738) CALCULATION OF EXPLOSION-PRODUCED CRATERS. J. B. Knox and R. W. Terhume (California. Univ., Livermore. Lawrence Radiation Lab.). [1963]. Contract W-7405-eng-48. 37p. (CONF-470-3).

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

This study develops a simple, two-dimensional, numerical-physical model of cratering physics for high-explosive sources in alluvium during the gas acceleration phase of excavation. The model requires knowledge of the earth's free-surface topography and motion at the time the gas acceleration begins (t_C), and the cavity pressure and volume. At t_C, the overburden material between the cavity and the free surface is assumed to be a homogeneous, incompressible, viscous fluid. Initially (e.g., at t_C) the cavity is approximated by two hemispheres: (a) the radius of the lower hemisphere is calculated by a one-dimensional, hydrodynamic, plastic-elastic model, and (b) the radius of the upper hemisphere is calculated from mass conservation of the overburden material. The upper hemispheric surface is subdivided into elemental surface areas, and mass zones are defined which subtend these elemental surface areas. By applying Newton's second law with a Newtonian friction (calibrated on the Scooter event) to each mass element, and by assuming that the cavity gas behaves adiabatically, the cavity evolution, mound development, and the formation of the lip through up-thrust are numerically simulated. With the development of a calibrated, numerical simulation model of excavation processes during the gas acceleration phase, the capability of the model to estimate crater radii and depth for ½-kt, high-explosive (H.E.) sources at various emplacement depths is explored. Assuming a reasonable angle of repose for alluvium, 45°, crater radii for scaled depths of burst from about 10 to 65 m are predicted. These estimated crater radii compare very favorably with the observed crater radii (Nordyke, 1961) for H.E. in alluvium. Further, the crater depths, for certain types of craters, are also reasonably predicted. The unsolved problems requiring solution for the development of a predictive model for cratering with nuclear explosives are discussed. (auth)

20124 (UCRL-7761) CHARACTERISTICS OF RADIOACTIVITY PRODUCED BY NUCLEAR EXPLOSIVES. John A. Miskel (California. Univ., Livermore. Lawrence Radiation Lab.). [1961]. Contract W-7405-eng-48. 13p. (CONF-470-7)

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

The amounts and kinds of radioactivities produced by detonation of a nuclear explosive are dependent upon the specific design of the explosive. The two design extremes are a pure fission device, which will produce about 1.4×10^{23} fissions, and therefore about 2.8×10^{23} fission products, per kiloton of energy released, and a pure thermonuclear device which would produce no fission products, but would produce approximately 10^{23} atoms of tritium per kiloton. In both cases, interaction of escaping neutrons with the materials of the device itself, and with the surrounding media, could lead to further radioactivities. The behavior and ultimate fate of the activities produced by the explosion depend on the composition of the medium in which the detonation occurs, the nature of the detonation, and the chemical species involved. Some typical cases are described. (auth)

20125 (UCRL-7762) CALCULATION OF THE SHOCK WAVE FROM AN UNDERGROUND NUCLEAR EXPLOSION IN GRANITE. Theodore R. Butkovich (California. Univ., Livermore. Lawrence Radiation Lab.). [1964]. Contract W-7405-eng-48. 22p. (CONF-470-5).

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

The capability of calculating the close-in effects of the shock wave from an underground nuclear explosion has been demonstrated. Agreement was obtained between calculation and measurements using a spherically symmetric, hydrodynamic, elastic-plastic code called SOC for the Hardhat event, a 5-kiloton nuclear detonation in granite. This capability is dependent upon having a more or less complete description of the elastic and dynamic properties of the materials involved. When this information is available, agreement within the limits of uncertainty of the measurements can be calculated for peak pressures, peak particle velocities, shock wave time of arrival, and pressure pulse shapes. (auth)

20126 (UCRL-7770) HEAVY ISOTOPE PRODUCTION BY NUCLEAR DEVICES. D. W. Dorn (California. Univ., Livermore. Lawrence Radiation Lab.). [1962]. Contract W-7405-eng-48. 18p. (CONF-470-4)

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

Since the 1952 thermonuclear detonation, "Mike," there has been interest in use of nuclear explosives to achieve very high neutron exposures, greatly in excess of those available from reactors. Fields which could benefit from these grossly increased fluxes are: nucleogenesis, nuclear structure of the very heavy elements, fission processes, stability trends in the heavy nuclei, and chemistry of new elements. Counting Mike, there have been four successful experiments in this field. A figure of merit for these shots is the ratio of the amount of elements produced with mass number equal to 246 to that of mass number 245. This ratio, R, depends sensitively on the thermal flux achieved.

Shot	Sponsoring Laboratory	Date	$R \equiv \frac{A = 246}{A = 245}$	Implied thermal flux (moles n/cm^2)
Mike	LASL	11/52	0.38	2.0
Anacostia	LRL	11/62	0.48	2.5
Kennebec	LRL	6/63	0.69	4.7
Anchovy	LASL	11/63	0.4	2.0

Since Mike, all experiments have used devices of low yield which can be readily contained underground. Conceptual designs now exist which should be able to give considerably higher neutron exposures. (auth)

20127 (UCRL-7773) THE EFFECTS OF SEISMIC WAVES ON STRUCTURES AND OTHER FACILITIES. Lewis J. Cauthen, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). [1964]. Contract W-7405-eng-48. 40p. (CONF-470-6)

From 3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964.

The effects of explosion-induced ground motion must be evaluated in planning and executing any nuclear excavation project. For some projects ground motion intensity may dictate the use of less-than-optimum yields to minimize damaging effects. In remote areas, weighing the alternatives of outright purchase of some property or use of smaller yields may be required. The cost of indemnifying owners against damage must be considered in any case. Discussions of the effects of ground motion on three broad types of facilities—engineered structures, residual buildings, and equipment required for the support of nuclear excavation operations—are presented. A method of predicting the response of single- and multistoried buildings, the response spectrum technique, is discussed, with emphasis on the application of explosion-induced spectra. Conclusions drawn from several tests of damage to residential-type buildings are presented. Included are data from four investigations of damage caused by commercial and industrial blasting and the results of several studies made in conjunction with underground nuclear detonations. Finally, a survey of damage to the equipment required to carry out excavation projects is summarized. (auth)

Facilities and Equipment

Refer also to abstracts 21452, 21453, 21456, 21492, and 21538.

20128 (ACNP-64021) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, January 1, 1964—March 31, 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Apr. 10, 1964. Work Performed under United States—Euratom Joint Research and Development Program. Contract AT(11-1)-1186. 80p.

Testing of centrifugal type downflow separators in the steam-water loop is complete. Preliminary analysis shows that the pressure drop is slightly less in steam-water than in air-water and that the equations which predict separating length requirements are valid in both media. Tests of the necked-down riser concept in the 36-degree segment of a 7-ft diameter vessel are complete. They show that carry-under is minimized when the riser height is equal to the riser diameter. The 8-inch diameter centrifugal upflow type separator tests show a capacity of 2000 gpm with 6 ft of water pressure drop. A 10-inch diameter separator is now being tested. Preliminary results show that it will have a capacity of 3000 gpm. The same analytical approach is being used in the design of this separator as in the centrifugal downflow separator. A hooded crossover type separator is designed and fabricated. Preliminary tests show that it is the best type tested to date. This unit is very effective in reducing carryover and still has very low pressure drop. (auth)

20129 (ARL-64-29) THREE-PHASE AC ARC HEATER. R. Phillips, D. Geister, P. Handy, and S. Bowen (Michigan. Univ., Ann Arbor). Feb. 1, 1964. Contract AF33(657)-8630. 145p.

Experimental and theoretical investigations into the technology associated with three-phase a-c arc heaters are presented and critically discussed. The behavior of the three-phase arc is extensively considered and it is shown that a previously reported analysis can adequately predict this behavior. The problems of designing arc heater components are discussed and in particular those associated with the pressure vessel. It is shown that the present, low pressure chamber extracts an unacceptable amount of energy from the arc heated gas resulting in a rather low unit efficiency. Finally, the benefits which might result from coupling a magnetogasdynamic accelerator to the arc heater for flight simulation are discussed and on the basis of perfect accelerator performance (no losses) it seems that significant increases in stagnation properties can be effected. (auth)

20130 (LADC-5817) PRESTRESSED CONCRETE SPHERICAL CONTAINMENT VESSEL. D. W. Mueller, A. P. Furnish, and A. C. Bateman (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 10p.

A 5-ft-OD, 4-ft-ID concrete spherical shell with a $\frac{1}{16}$-in.-thick inside steel shell and a $\frac{1}{8}$-in.-thick outside steel skin, was designed and tested for containment of explosions. The prestressing was obtained by making the outside steel skin of twelve flanged pentagons which were bolted together. Results are reported of tests with up to 3.25 lb high explosives; at this weight, the seams started to break but the failure was not catastrophic. The peak residual hot gas pressure was 209 psi for 3.25 lb explosive. The extension of the data to a 20-ft-OD, 16-ft-ID structure is discussed. (D.L.C.)

20131 (NAA-SR-Memo-2368(Rev.)) DESIGN OF TWO PERMANENT-MAGNET-ROTOR PUMPS FOR LIQUID METAL. R. S. Baker (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 27, 1957. Contract AT(11-1)-Gen-8. 27p.

A mathematical investigation of permanent magnet rotor pumps for liquid metals was made and recommendations for pump dimensions are made. A pump was designed for sodium for 6 gallons per minute at 1000°F at 3 psi internal pumping pressure and for lithium for 3 gallons per minute at 1000°F at 1 psi internal pumping pressure. Two-pole permanent magnet rotors are recommended. (R.E.U.)

20132 (NAA-SR-Memo-8289) DESIGN OF ELECTRON BOMBARDMENT HEATER FOR SODIUM. R. S. Duncan and R. A. Mohr (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 8, 1963. Contract AT(11-1)-Gen-8. 15p.

A sodium heater was designed to develop 3 to 16 kw of heat inside a 2 inch length of $\frac{1}{4}$-inch O.D. × $\frac{5}{32}$-inch I.D. molybdenum tube. The heater is essentially a vacuum tube with an indirectly heated cathode. The thermionic emission current from the cathode is accelerated to the anode by a large accelerating potential. The energy given up by the electrons as they arrive at the anode appears as heat in the anode. The design suggested in the feasibility study consisted of a directly heated "V" shaped filament used as the electron emitter. From a mechanical design viewpoint, this configuration would be difficult to support and/or replace. The design arrived at utilizes a tubular-shaped thoriated tungsten cathode heated indirectly by a molybdenum filament within the tube. This configuration appears to offer a substantial structural advantage. The calculations show that 16 kw can be produced by a diode of the given dimensions. They also show that the temperatures, current values, and voltage values are within a reasonable operating range for the proposed materials. (auth)

20133 (NYO-9802) HIGH-PRESSURE PUMP SEAL DEVELOPMENT. Engineering Quarterly Progress Report, March–May 1963. R. C. Hajner (Worthington Corp. Advanced Products Div., Newark, N. J.). June 10, 1963. Contract AT(30-1)-2682. 19p.

The model seal test program was concluded during this Quarterly Report. The final test, 1014 hours in duration, was conducted at a sealing pressure of between 2100 to 2300 psig and at a leakage rate of 2.14 gph. The seal face materials evaluated were an aluminum oxide rotor running against a stator face made of tungsten carbide for the high pressure seal and Graphitar 39 for the low pressure element. Optical examination of the faces after the test showed no measurable wear. Nine unscheduled shutdowns were made during the test without damaging the seal faces or affecting the performance of the seal after each startup. The shutdowns were automatically accomplished in a predetermined sequence through a control system which was calibrated to monitor the test and stop it in the advent of equipment failure. The manufacture of the full size seal ($5\frac{1}{2}$-inch shaft diameter) is 50% complete. All of the test equipment and instrumentation for the full size test rig has been received and assembled. The full size seal is scheduled for assembly by mid August 1963. (auth)

20134 (ORNL-TM-792) SOME DEVELOPMENTS IN ENGINEERING, FABRICATION, AND FIELD SUPPORT OF LABORATORY PROGRAMS. Report II, October 1962–March 1963. H. E. Seagren (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 57p.

Much of the development work in the past year involved finding solutions to problems in alpha-neutron-gamma facility operations, in reactor operations and components, and in special requirements for research equipment. Techniques for working with and joining new materials presented special fabrication problems. For most development items, a problem is indicated and a summary presented of the procedure, technique, or equipment used to solve the problem. Reference is made to the program or division for whom the development work was accomplished. An index of problems is presented for both this report and the report for the previous six-month period, ORNL-CF 62-9-91. (auth)

20135 (TID-20448) THE APPLICATION OF GAS-LUBRICATED BEARINGS TO HIGH-SPEED, TURBOMACHINERY. Quarterly Technical Report, September 1, 1963 to November 30, 1963. J. G. Hinkle, E. J. Gunter, Jr., and D. D. Fuller (Franklin Inst. Labs for Research and Development, Philadelphia). Contract AT(30-1)-2512. 19p. (Q-A2392-3-11)

Effort is applied to the design and analysis of both self-acting and externally-pressurized gas-lubricated bearings. The following specific bearing and rotor characteristics when operating on self-acting, pivoted pad, gas-lubricated bearings are reported: the effect on journal center and shoe motion of unbalance placed in the plane of the center of gravity of the shaft and the effect on journal center and shoe motion of misalignment of the bearing support stanchions, and results of continuous running at design speed. A preliminary outline of the design manual presently being compiled is given. (auth)

20136 A SECONDARY EMISSION CATHODE. B. O. Baker (General Electric Co. Ltd., Wembley, Eng.). p.1-6 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In a gaseous discharge tube a considerable current density can be drawn from a metal surface below thermionic emitting temperature, if the surface has become coated by emissive materials evaporated from a nearby thermionic

cathode. Possible mechanisms for this emission are discussed, together with experiments in various gases to determine the basic processes involved. (auth)

20137 THE INFLUENCE OF MOLECULAR ION MASS ON TOWNSEND'S SECONDARY IONIZATION COEFFICIENT. A. E. D. Heylen (Univ. of Leeds, Eng.). p.7-9 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The number of electrons released per positive ion impinging on a metal surface was measured in the range $100 \leq E/p \leq 3000$ volt cm^{-1} mm^{-1} Hg for the gases methane, ethylene, acetylene, and isopentane. It is found that Townsend's secondary ionization coefficient, γ, varies over the wide range $10^{-8} \leq \gamma \leq 10^{-1}$; for all gases the rate of increase in γ decreases with increase in E/p until at high E/p a saturation value is reached. At a particular value of E/p, γ is determined solely by the molecular ion mass and is not influenced by the ionization energy of the molecule or the chemical nature of the bonds. These observations suggest that ejection of electrons from a metal surface by the impact of molecular ions takes place by the kinetic energy exchange process. Comparison with results obtained by others from sparking potential values and from direct measurements supports these conclusions and interpretation. (auth)

20138 ELECTRICAL BREAKDOWN BETWEEN A SPHERE AND A PLANE IN VACUUM. K. W. Arnold, R. B. Britton, S. C. Zanon, and A. S. Denholm (Ion Physics Corp., Burlington, Mass.). p.101-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The d-c vacuum breakdown voltage V was measured as a function of electrode separation d, sphere diameter D and ambient pressure p for electrodes with sphere-to-plane geometry. Values of V up to 1.7×10^{6} volts were attained during experiments in which d was varied from 1 to 20 cm, D from 0.16 to 5 cm and p from 1×10^{-3} to 1×10^{-7} torr. Electrodes were made of stainless steel type 304, buffed to a good polish. The maximum macroscopic electric field $\underline{E}_s$ at the spherical surface was calculated for each experimental point, and it was determined that the data do not fit the Cranberg hypothesis, $V\underline{E}_s$ = constant, for the sphere having either polarity. (auth)

20139 CATHODE ELECTRON EMISSION AND VACUUM BREAKDOWN. W. D. Owen and F. Llewellyn-Jones (Univ. of Wales, Swansea). p.105-10 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Continuous currents $\sim 10^{8}$ electrons/sec and current pulses $\sim 10^{13}$ electrons/sec were measured using an electrometer, in an investigation of the build-up of current between treated electrodes of nickel and of gold at residual gas pressures $\sim 10^{-5}$ mm Hg. The continuous current was found to be field dependent in the range 1.8 to 3.6 10^{5} v/cm. The results were compared with those obtained using a statistical time lag technique to measure initiatory electron emission in gases. The mechanism of vacuum breakdown is discussed in relation to the essential part played by gas layers adsorbed on the electrodes. (auth)

20140 DISCHARGE MECHANISM IN VACUUM. C. Germain and F. Rohrbach (CERN, Geneva). p.111-17 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Direct-current breakdown tests at pressures between 10^{-6} and 10^{-3} torr were made with different materials as electrodes spaced from 1 to 10 centimeters. Theories proposed during the last few years seem unable to explain completely the experimental results. A critical account of a few of these theories is given and a possible development of one of them is proposed. The principal parameters studied are: geometry, surface state, and electrode material, as well as effects of residual pressure on breakdown voltage. (auth)

20141 SPARK CONDITIONING OF ELECTRODES AT PRESSURES IN THE RANGE 10^{-5}–10^{-6} mm Hg. A. Maitland (Associated Electrical Industries Ltd., Manchester, Eng.). p.119-24 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Pulses of 4.5 μsec duration were applied to plane and point-plane electrode systems of various materials and surface finishes. Breakdown probability falls to a minimum but then increases again when a secondary stage of electrode damage is reached. It is shown that the number of sparks required to produce a given conditioned state increases with the degree of roughness and depends predominantly on the anode surface. The electrode erosion produced is confined to the anode of a plane electrode system and the high field electrode of a point-plane system. Breakdown voltages for polished electrodes are about 25% higher than those for the roughest electrodes studied. On the basis of results described, some general aims of conditioning are suggested, and a new criterion for assessing the efficacy of a conditioning procedure is proposed. (auth)

20142 ON THE FORMATION OF AN ELECTRIC ARC IN VACUUM. Max Goldman and Alice Goldman (CNRS, Ivry, France). p.125-7 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Experimental results which corroborate the hypothesis that the final stage of breakdown is initiated by anode vaporization are presented. An attempt is made to give a simplified mathematical form for the observed phenomena. It is assumed that the vapor issued from the anode reduces progressively the space charge between the electrodes. Thus, the current density, given by the Langmuir equation, is no more connected to a function f(d) of the interelectrode distance, but to a function f(d-vt), where v is the mean spread velocity of the ionized anode vapor during its anode-cathode travel. (auth)

20143 EMISSION PROCESSES AT THE CATHODES OF VACUUM ARCS. K. W. Arnold and A. H. Von Engel (Oxford Univ.). p.129-32 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol II." Paris, SERMA, 1963.

The rotating drum method was used to measure the velocity distribution in the vapor jet which emerges from the cathode region in a magnetically stabilized vacuum arc discharge between cooled copper electrodes. Part of the cathode was made of radioactive copper, and the number distribution of radioactive atoms deposited on the drum as a function of their velocity perpendicular to its surface was measured by a Geiger-Müller counter. An average velocity $\bar{v}$ of about 4×10^{4} cm/sec was found for the atomic beam. Consideration of the mechanisms by which copper might be evaporated from the cathode spot of the arc shows that the temperature of the spot is too low to account for the copious emission observed. A new evaporation mechanism is suggested by which ablation of the cathode is caused by the impact there of excited vapor atoms. Experimental evidence is given to support the conception of the impor-

tance of excited atoms in the cathode ablation process. (auth)

20144 THE EMISSION MECHANISM AND RETROGRADE AND FORWARD MOTION OF COLD-CATHODE ARCS. A. E. Guile, T. J. Lewis, and P. E. Secker (Univ. of London). p.283-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol II." Paris, SERMA, 1963.

A new mechanism of cold-cathode arc emission is postulated, based on the concept of a high electric field existing across a thin semiconducting layer (generally oxide) on the cathode surface. Electrons are emitted from this into the gas region with appreciable velocities parallel to the electrode surface and give rise to ions on the forward and retrograde sides of the existing emitting site. Variations in the number of ions produced on the two sides are considered under varying conditions of magnetic-field, pressure, and current for vacuum and gas arcs, and characteristics for retrograde velocity and immobility are deduced. These are compared with experimental results and are found to agree well. (auth)

20145 CONTRIBUTION TO A STUDY OF PREBREAKDOWN DISCHARGE BETWEEN POINT AND PLANE. G. Hartmann, A. Goldman, G. Buchet, and A. Zeitoun (CNRS, Ivry, France). p.301-3 of "VI^e Conférence Internationale sur lex Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

The appearance of prebreakdown discharge in air at atmospheric pressure with positive point-plane geometry and d-c applied voltage was studied. Phenomena described by others and other ones not yet mentioned were discussed. Individual light pulses were studied by means of an ultra-high-speed camera and photos were compared with observed current pulses. Study of cathode erosion, with negative point, led to a new hypothesis on the space charge effect. (auth)

20146 FORMATION STAGE OF SPARK BREAKDOWN IN POINT-TO-PLANE GAP IN AIR (NEGATIVE POINT). Yasunori Miyoshi, Tatsuzo Kosokawa, and Makoto Hayashi (Nagoya Inst. of Tech., Japan). p.327-9 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The static breakdown of negative point-to-plane gap showed that the gap conditions could be classified in 3 regions, $1 < 1_C$, no corona region, $1_C < 1 < 1_G$, pulsive corona region, and $1_G < 1$, pulseless corona region, corresponding to types of corona discharge preceding to spark. The study of impulse breakdown shows that irrespective of discharge regions mentioned above, there are 3 stages of breakdown — pulsive corona → pulseless corona — spark although time lags seem not to obey Laueplot distribution. (auth)

20147 PRESSURIZED TRIGATRONS WITH A 10 kv–50 kv LOW JITTER OPERATING RANGE. George Goldenbaum (Univ. of Maryland, College Park) and Eduard Hintz. p.331-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

By using enclosed switches at higher pressures and smaller electrode spacing the breakdown characteristics of asymmetric trigatrons, described in detail by Lupton, were further improved. The mechanical construction remains simple and voltages up to 50 kv can be switched. At electrode distances from 3 to 5 mm and pressures between 15 and 75 psi both statistical and formative time lags are below 20 mμsec, even with the operating voltage as low as one-third of the static breakdown voltage. The comparatively small breakdown voltage in the triggered case with the observed short delay times is caused by the increasing nonuniformity of the electric field when the trigger potential is raised, and by an intermittent corona between the trigger pin and the main electrode which starts during the charging period. (auth)

20148 THE BREAKDOWN OF THIN WIRE-PLANE GAPS AND POINT-PLANE GAPS IN ELECTRON ATTACHING GASES AND NON-ATTACHING GASES. E. Kuffel and N. Singh (Univ. of Manchester, Eng.). p.343-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol II." Paris, SERMA, 1963.

Breakdown voltages of thin wire-plane gaps and point-plane gaps were measured in dry and moist air, dry and moist argon, in nitrogen and in mixtures of nitrogen and oxygen under direct voltages of either polarity. The breakdown stress in dry argon and in nitrogen was found to be lower for the negative applied voltage than for the positive voltage. Addition of small amount of water vapor to argon caused a large increase in the negative breakdown characteristics. It had negligible effect on the positive breakdown stress. The results were the same for the point-plane and wire-plane gaps. In air either dry or humid high breakdown stresses were observed for thin wire-plane gaps under both positive and negative voltages. The voltage-spacing relation remained linear over a wide range of gaps. Similar results were obtained in mixtures of argon and air, but the high positive breakdown stress was observed only when the content of air exceeded about 23% of the mixture by volume. (auth)

20149 TRIGGERING OF UNDERVOLTED SPARK GAPS BY A MICROSECOND PULSE OF FAST ELECTRONS. J. D. Clarke and P. J. Hutton (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.347-51 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Triggering of undervolted spark gaps by an intense volume-ionizing pulse was investigated experimentally and theoretically. Nitrogen- and hydrogen-filled gaps with static breakdown potentials of 1.2–13 Kv were traversed by an 0.8 μsec pulse of relativistic electrons. The minimum triggering voltage fell with increase in pulse strength to as little as 20% of static. A theory of the effect is based on the hypothesis that breakdown ensues, if field distortion by space charge is such that the Townsend criterion for static breakdown is fulfilled. Order of magnitude agreement with experiment is obtained with even a crude version of this theory; there is better agreement with less approximate numerical computations, if for the electron ionization coefficient in nitrogen, the values of Masch and Posin are used. (auth)

20150 NEGATIVE IMPULSE BREAKDOWN OF LARGE SPHERE-PLANE GAPS. G. R. Govinda Raju (Univ. of Liverpool) and D. J. Badkas. p.353-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The mechanism of breakdown of sphere-plane gaps in air was studied up to a spacing of 200 cm. Breakdown and corona onset voltages are given for sphere-plane gaps with 30 cm and 50 cm diameter spheres. Corona streamers which preceeded the breakdown crossed the gap with a velocity of the order of 10^8 cm/sec. When a chopped impulse voltage was applied the gap was covered by a diffuse glow which gave rise to the final phase of the breakdown. Depending on the diameter of the sphere three breakdown criterion were observed. An attempt is made to give qual-

itative explanations for the development of these streamers. (auth)

20151 ON THE MECHANISM OF INITIAL CONTROL OF A SPARK GAP. A. Goldman, M. Goldman, and J. Reinhardt (CNRS, Ivry, France). p.361-3 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

In a trigatron, the leader of the initiating spark has an important part in its mechanism of breakdown. When expanded, it takes a roughly conical shape and can be considered as a conductor which reduces the breakdown interval and modifies the sphere-sphere geometry into a point-sphere one. (auth)

20152 FIELD EMISSION FROM SEMI-CONDUCTORS. W. F. Gunn, P. G. Davies, and W. MacDonald (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). p.383-5 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Results of statistical time lag measurements on clean 111 p and n type semiconductor electrode materials are presented for a range of temperatures and pressures, the results are discussed, and a comparison is made with field emission from metals in similar conditions. (auth)

20153 BREAKDOWN IN CROSSED ELECTRIC AND MAGNETIC FIELDS AT LOW PRESSURE. C. F. Gozna (Marchwood Engineering Labs., Southampton, Eng.). p.389-92 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Measurements of the sparking potential were made between coaxial cylinder electrodes in air at low pressures. The effect of changes in gas pressure, configuration of the magnetic field, and ratio of the radii of the electrodes was investigated. A discussion is given in terms of the theories of breakdown under these conditions. (auth)

20154 ON THE PENNING-DISCHARGE WITH HEATED CATHODE AND ITS APPLICATION AS AN ION SOURCE. S. V. Goler and H. Wagner (Universität, Marburg, Ger.). p.405-10 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

The discharge characteristics of an ion source with oscillating electrons were measured. A simple theory, resulting from the particle conservation equations, is compared with the experimental data. It takes account of the essential features as the dependence on pressure, cathode heating, and magnetic field. A formula is derived that gives the correlation between the arc data and the extracted ion beam in satisfactory agreement with the experiments. (auth)

20155 ANNULAR SOURCE OF IONS IN CROSSED FIELDS. A. Bariaud, J. Coutant, J. Druaux, and F. Prevot (Euratom-CEA, Fontenay-aux-Roses, France). p.411-21 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

An annular discharge in hydrogen, at low pressure, about one meter in diameter, is obtained by crossed fields E_r B_z. This discharge is used as an ion source. The ion beam leads the discharge through a circular slot and converges toward the center. Characteristics of the discharge and the beam current are given. Angular and energy dispersion are roughly measured. A maximum intensity of 200 mamp in the beam was obtained. Different current fluctuations are found in the range 0-1 MHz. One kind of fluctuation seems to be due to an instability in the discharge, and another one is a density perturbation rotating at the drift velocity E_r/B_z. (auth)

20156 THE DYNAMIC OPTIMIZATION OF A TWO-STAGE REACTOR SYSTEM. Robert Douglas Thibodeau. Thesis, Evanston, Ill., Northwestern Univ., 1963. 207p.

The present concepts of dynamic optimization were examined. The objective was two-fold; the presentation of the theory in a less general, more comprehensible form, and the application of the principles to the analysis of a realistic system—a multi-stage, nonlinear, dynamic system subject to stochastic variations in its many inputs. The state transition viewpoint of a general nonlinear system whose performance depends upon the random changes in its inputs and environment was investigated. The objective was the establishment of a general control law specifying how the manipulatable variables of the system should be controlled so as to extremize some measure of system performance without transcending the physical constraints on the system. The theories of calculus of variations, the principle of optimality, and the maximum principle as they would apply to the establishment of a control law are presented in considerable detail. Application of the developed theories to the analysis of a two-stage continuous stirred tank reactor system to develop a sampled-data control law is also considered. A stoichiometric objective function, namely, the time-average value of conversion, is extremized via the calculus of variations, resulting in a non-analytical expression for the control law when the inequality constraints are included via penalty functions and in an analytical bang-bang control law resulting from an analysis in which the inequality constraints are included by a parametric representation. (Dissertation Abstr., 24: No. 9, March 1964)

20157 THE CENTRIFUGAL PLASMA JET FURNACE. A. V. Grosse, P. J. McGonigal, W. J. Murphy, and C. S. Stokes (Temple Univ., Philadelphia). 20p. (CONF-433-3)

From American Society for Testing Materials 1964 International Conference on Materials, Philadelphia, Feb. 1963.

A centrifugal plasma jet furnace for high temperature research above the limit set by the melting points of refractory materials is discussed. The design and operation of the furnace are described. (C.E.S.)

20158 A HIGH-EFFICIENCY MAGNETIC-FIELD DESIGN FOR LARGE ION PUMPS. W. J. Kearns (General Electric Co., Schenectady, N. Y.). 15p. (CONF-209-27)

From American Vacuum Society Meeting, Boston, Oct. 1963.

The general problem of establishing a magnetic field over a large area that has a wide enough gap spacing and high enough field to be useful for ionic pumping is discussed. (C.E.S.)

20159 APPARATUS PERMITTING THE REMOVAL OF RIVETS FROM TUBULAR MEMBERS. Horst Hermann (to Communaute Europeenne de l'Energie Atomique (EURATOM)). British Patent 955,381. Apr. 15, 1964. Priority date Dec. 9, 1961, France.

An apparatus is described for the remote removal of rivets from the tubular casings of spent fuel elements or rods in such a manner that the casings may be reused. The apparatus includes a knocking-out punch supported and guided by an operating mechanism, a mandrel for sliding in the interior of the tubular casing, and an abutment member which is applied against the casing in a direction opposite to the punch movement. The operation of the apparatus is described. (D.L.C.)

Heat Transfer and Fluid Flow

20160 (AD-423679) INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER. Second Quarterly Progress Report. Richard E. Balzhiser, Robert E. Barry, Bruce F. Caswell, Herman Merte, Jr., Andrew Padilla, Jr., and Lowell R. Smith (Michigan. Univ., Ann Arbor. Coll. of Engineering). Nov. 1963. Contract AF33(657)-11548. 33p. (ORA-05750-6-P)

The high flux nucleate pool boiler was cleaned of potassium and recharged with water in an attempt to obtain burnout data which might be compared with existing data for other geometries. Two burnouts were experienced accidently and neither yielded accurate values. Recalibration of thermocouples used in the film boiler has revealed substantial drift. Efforts to stabilize and calibrate the microthermocouples prior to rerunning the potassium are continuing. Additional pressure drop data were obtained prior to draining the loop of potassium and sodium. Proposed test section modifications were studied. Agravic studies have progressed to the assembly and checkout stage. (auth)

20161 (AEEW-R-178) EXPERIMENTAL STUDIES INTO THE EFFECT OF ROD SPACING ON BURNOUT IN A SIMULATED ROD BUNDLE. D. H. Lee and R. B. Little (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Aug. 1962. 46p.

Tests on a dumb-bell shaped flow passage simulating the gap between rods in a fuel element indicated that burnout was not significantly affected by inter-rod gap in the range 0.032 to 0.22 inch. Test conditions were: ~960 psia, 2×10^6 lb/ft^{2}hr mass velocity, and 10% mean exit quality with vertical upflow of water. (auth)

20162 (EUR-1622.f) VISUALISATION DE L'ÉBULLITION NUCLÉÉE DE L'EAU A PRESSION ATMOSPHERIQUE ET MESURE SIMULTANEE DES VARIATIONS DE TEMPERATURE DE SURFACE. (Visualization of Nucleate Boiling of Water at Atmospheric Pressure and Simultaneous Measurement of Surface Temperature Variations). C. Bonnet, E. Macke, and R. Morin (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 23p.

A study was made on local wall temperature fluctuations due to the formation of isolated bubbles in poolboiling of water at atmospheric pressure. Those temperature fluctuations are made visible by the elongation of a luminous spot in the same optical plane as the phenomenon. The whole is filmed with a high speed camera. The setup of Ni-Ni Cr thermocouple for measuring rapid surface temperature variations is described. In agreement with the experimental results, a physical model of bubble formation based on a one-dimensional mathematical model is presented. (auth)

20163 (EURAEC-952) AN ISOKINETIC SAMPLING PROBE FOR PHASE AND VELOCITY DISTRIBUTION MEASUREMENTS IN TWO-PHASE FLOW NEAR THE WALL OF THE CONDUIT. Topical Report No. 12. N. Adorni, P. Alia, L. Cravarolo, A. Hassid, and E. Pedrocchi (Centro Informazioni Studii Esperienze, Milan). Dec. 1963. Work Performed Under United States Euratom Joint Research and Development Program. Contract 060-61-7-RDI. 48p. (CISE-R-89)

A description is given of an isokinetic sampling probe specially developed for phase and velocity distribution measurements in two-phase (gas+liquid) flow, in the region close to the wall of the test section conduit of a high pressure facility. Experimental data obtained during preliminary tests both in single and two-phase flow are also presented. The experiments in two-phase flow were carried out under the following conditions:

Flow: vertical upward (annular-dispersed regime)
Geometry: circular conduit 25 mm ID
Fluids: { gas phase: nitrogen ($\rho_g = 27.7 \times 10^{-3}$ g/cm^3)
liquid phase: water
Gas flow rate: 25 to 70 g/cm^2 sec
Liquid flow rate: 70 to 200 g/cm^2 sec
Temperature: ~18°C
Pressure: ~24.5 kg/cm^2 abs (auth)

20164 (EURAEC-1004) PRESSURE DROPS IN STEAM–WATER MIXTURES. ROUND TUBES—VERTICAL UPFLOW. G. P. Gaspari, C. Lombardi, and G. Peterlongo (Centro Informazioni Studi Esperienze, Milan). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contracts 060-61-7 RDI and 056-62-1 RDI. 140p. (CISE-R-83)

All the pressure drops results obtained during CAN-2 and CAN-3 programs for steam–water mixtures in vertical upflow with round tubes are discussed. Correlations are given for predicting pressure drops both in adiabatic and in heat transfer conditions. The range explored is:

D = 0.5–2.5 cm
L/D = 20–550
P = 50–90 kg/cm^2
G = 100–400 g/cm^2 sec
X_{in} = covering the whole range from subcooled water to saturated steam.

The following topics are examined: experimental procedure, description of the test elements, presentation of experimental data, discussion of adiabatic pressure drops, discussion of pressure drops in heat transfer conditions with uniform and nonuniform axial power distribution, influence of hydrodynamic inlet conditions. (auth)

20165 (NAA-SR-Memo-8123) AN ANALYTICAL MODEL FOR THE TRANSIENT BEHAVIOR OF TWO-PHASE FORCED CIRCULATION FLOW THROUGH CHANNELS PERMITTING CROSS-FLOW. L. R. Steele (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 14, 1963. Contract AT(11-1)-Gen-8. 24p.

Equations are presented that can be used to predict the transient void distribution and flow rate distribution of a boiling reactor coolant. Cross-flow, radial and axial power distribution, and radial inlet flow distribution can be handled. The only controls on the system are the heat flux and the input flow rate, which may be a function of the pressure drop across the core. A solution of these equations should yield a transfer function relating a change in input in the form of flow rate or heat flux to a change in the void fraction in the core. These equations may also be coupled to the nuclear characteristics to give the transient behavior of the entire core. Two modifications of this model are included; a single channel model that can handle an axial power distribution and a single-channel model that must use a uniform power distribution. (auth)

20166 (NP-13810) INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER. Quarterly Progress Report No. 3. Richard E. Balzhiser, Robert E. Barry, Bruce F. Caswell, Herman Merte, Jr., Andrew Padilla, Jr., and Lowell R. Smith (Michigan. Univ., Ann Arbor. Coll. of Engineering). Feb. 1964. Contract AF33(657)-11548. 34p. (ORA-05750-9-P)

Burnout data were obtained for water and sodium in the same equipment used previously for potassium studies. These data confirm Addom's water data and Noyes' sodium data remarkably well. Recent film boiling data obtained by condensing sodium on the bottom side of a horizontal disk on top of which potassium is boiled have yielded inconclusive results. Stable film boiling was observed to have occurred with the pressure in the potassium chamber less than 1 inch of mercury. Upon increasing the power to the sodium instabilities were observed which caused the system to oscillate as if in the transition regime. Agravic studies with mercury at accelerations up to 20 gees were delayed by an equipment failure. The forced circulation apparatus was used to obtain additional two phase pressure drop data after which it was shut down and the test section removed for repair. A brittle failure had occurred in the Haynes-25 bellows which had permitted sodium to enter the potassium system. An analysis of the two phase pressure drop data has revealed departures from the Martinelli-Nelson or Lockhart type of correlation. Similar deviations were observed with other data for metallic fluids. A friction factor correlation is proposed which correlates data for metallic systems. (auth)

20167 (NP-13812) VOID FRACTION MEASUREMENTS IN CAVITATING MERCURY. Internal Report No. 22. Frederick G. Hammitt, Willy Smith, Ian E. B. Lauchlan, Richard D. Ivany, and M. John Robinson (Michigan. Univ., Ann Arbor). Feb. 1964. 35p.

A method is described for obtaining precise measurements of local density (or void fraction) in an axially symmetric two-phase flow or of mean density in a plane parallel to (or through) the centerline. The application of the method to cavitating mercury in a venturi test section is described. The basic flow measurements resulting are presented. (auth)

20168 (TID-7694) TWO-PHASE FLOW PROBLEMS. Proceedings of the Meeting of the Working Group Heat Transfer, Brussels, October 29–31, 1962. (United States–Euratom Joint Research and Development Program). 1963. 149p. (EUR-352.e)

Fifteen papers presented at the Meeting of the Working Group on Heat Transfer are given. A general discussion on burnout heat flux is also included. Separate abstracts were prepared for each of the 15 papers. (M.C.G.)

For abstracts of individual papers see: 20169, 20170, 20171, 20172, 20173, 20174, 20175, 20176, 20177, 20178, 20179, 20180, 20181, 20182, and 21617.

20169 (TID-7694(p.7-10)) USAEC TWO-PHASE FLOW PROGRAM. R. M. Scroggins (Division of Reactor Development. Engineering Development Branch, AEC).

A general description of the USAEC Two-Phase Flow Program, its purpose, present program, and future objectives, is presented. The necessity of this program for optimization of boiling-water reactors is discussed. The 22 research programs being carried out are described briefly. (M.C.G.)

20170 (TID-7694(p.11-17)) PRESENTATION OF THE TWO-PHASE FLOW PROGRAM AT ARGONNE NATIONAL LABORATORY. J. Marchaterre (Argonne National Lab., Ill.).

The research on two-phase flow is divided into two parts: that associated with the water reactor program and that associated with advanced systems and fast reactor safety programs. Studies were carried out on predicting the vapor volume fraction in boiling systems. A general correlation in terms of the velocity ratio was obtained. The entrainment of vapor in the downcomer in a reactor of the EBWR type was also investigated. Critical flow of steam-water systems is also being studied. Other problems being considered are: oscillation in natural circulation systems, boiling from a liquid-liquid interface, and boiling sodium behavior. (M.C.G.)

20171 (TID-7694(p.18-23)) STUDIES IN TWO-PHASE FLOW AND BOILING HEAT TRANSFER AT THE OAK RIDGE NATIONAL LABORATORY. H. W. Hoffman (Oak Ridge National Lab., Tenn.).

Research in heat transfer and fluid mechanics directed to increasing the heat-removal capabilities of nuclear reactors is discussed. Boiling heat transfer studies with water, ethylene glycol, freon, liquid metals, and slurries are described. Condensing heat transfer was studied with water, liquid metals, and air-water, steam-water, and potassium vapor-liquid systems. Results are summarized. (M.C.G.)

20172 (TID-7694(p.24-34)) TWO-PHASE FLOW AND HEAT TRANSFER STUDIES AT GENERAL ELECTRIC COMPANY. S. Levy, E. Janssen, E. E. Polomik, E. P. Quinn, and F. E. Tippets (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

Investigations of two-phase pressure drop and burnout heat transfer are described. Pressure drop data were taken in two-phase flow of steam-water mixtures at 600, 1000, and 1400 psia in rectangular channels. High-speed movies were made of the flow structure. The tests covered upward, downward, and horizontal flow directions. Extensive pressure drop results and movies were accumulated for the same conditions in simplified two-dimensional contraction-expansion geometries. Critical heat flux was determined in annular geometries heated on the inside surface only and in a 9-rod geometry. Observations were made of the occurrence of critical heat flux conditions at high pressure in a rectangular channel. Studies were made of methods for increasing the critical heat flux. (M.C.G.)

20173 (TID-7694(p.35-6)) TWO-PHASE FLOW STUDIES. R. Moissis (Massachusetts Inst. of Tech., Cambridge and Dynatech Corp., Cambridge, Mass.).

Work on two-phase flow in connection with the development of a time-variant, self-controlling outlet steam quality device in boiling-water nuclear reactors is described. The control device consists of two venturi tubes one each at the inlet and outlet of a reactor flow channel. The ratio of the pressure drops across the inlet and outlet tubes is a measure of the flowing quality. It was concluded that the transition from slug flow to froth flow is due to a Helmholtz hydrodynamic instability of the liquid film-to-bubble interface. The transition depended on the size of bubbles in the slug flow and on the pipe diameter. (M.C.G.)

20174 (TID-7694(p.37-41)) SOME CURRENT AND FUTURE RESEARCH IN TWO-PHASE FLOW AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY HEAT TRANSFER LABORATORY. W. M. Rohsenow (Massachusetts Inst. of Tech., Cambridge. Heat Transfer Lab.).

Studies on condensation of liquid metals, effects of surface character on boiling of liquid metals, film boiling in forced convection inside tubes, effect of electrostatic field on boiling, slug capillary flow, and slug flow in noncircular passages are summarized. (M.C.G.)

20175 (TID-7694(p.42-43)) A STUDY OF CONVECTION BOILING INSIDE CHANNELS. J. K. Ferrell (North Carolina State Coll., Raleigh).

Studies are being made on two-phase, single-component, frictional and expansion-contraction pressure losses.

Equipment was constructed and preliminary runs indicated that it is in working order. (M.C.G.)

20176 (TID-7694(p.44-51)) TWO-PHASE FLOW AND BOILING STUDIES. G. B. Wallis (Dartmouth Coll., Hanover, N. H.).

Studies are being made of two-phase flow and boiling in order to express the values of particular dependent variables (e.g., pressure drop, burnout, stability, flow pattern, and voidage) as functions of three types of basic parameters: fluid properties, apparatus geometry, and independently controlled variables such as inlet temperature, heat flux, and flow rates. Bubbly flow, slug flow, transition from slug to annular flow, annular flow, and onset of droplet entrainment are discussed. (M.C.G.)

20177 (TID-7694(p.53-60)) RESEARCH PROGRAM ON HEAT TRANSFER AND STABILITY PROBLEMS IN BOILING WATER REACTORS. M. Bogaardt and C. L. Spigt (Eindhoven, Netherlands. Technische Hogeschool).

Studies are being made of the steady-state and dynamical behavior of a boiling-water reactor. The characteristic quantities describing a two-phase flow system are being derived. The loop, test section, quantities to be measured, the testing program, and theoretical studies are described. (M.C.G.)

20178 (TID-7694(p.61-70)) INSTABILITIES IN BOILING WATER LOOPS. S. Fabrega (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble).

Instabilities in boiling-water reactors are being studied. An investigation on the 8-atm loop was undertaken with a view to employing the effective laws governing pressure drop in a mathematical model. Graphs are given showing boundaries at which oscillations occur under given conditions of geometry and pressure. Several types of oscillation phenomena were observed with a period ranging from 1 to 10 sec. The period in the region of the threshold increased with decreasing power for a given value of the pressure drop imposed. Other conditions remaining the same, it was found that there was an increase in the steam quality at the instability threshold and a lengthening of the periods. Instabilities were also investigated in a 1-atm loop. In certain cases there appeared to be a definite correlation between the instabilities and the burnout. A mathematical model to explain the instabilities is being developed. (M.C.G.)

20179 (TID-7694(p.85-6)) ANALYSIS OF VARIOUS BURNOUT DATA (LITERATURE RESEARCH) AND COMPARISON OF AVAILABLE DATA. H. H. Agena (Maschinenfabrik Augsburg-Nürnburg A. T., Nuremberg).

Critical analyses of burnout research results are being carried out. Three types of burnout correlations were considered: those established on a purely empirical basis, those based on criteria of the stability of the two-phase separation layer in unstable and stable film-boiling ranges and dimensional analysis of these criteria, and those based on dimensional analysis of the conditions of nucleate boiling. Eleven references are given. (M.C.G.)

20180 (TID-7694(p.87-8)) PREPARATION OF AND PRELIMINARY TESTS FOR BURNOUT MEASUREMENTS. F. Mayinger (Maschinenfabrik Augsburg-Nürnberg A. G., Nuremberg).

A test loop was designed and constructed for pressures up to 200 atm and temperatures up to 360°C at a maximum volumetric flow of 15 m^3/hr for measurements of burnout in boiling water. (M.C.G.)

20181 (TID-7694(p.89-107)) ADAPTATION OF VORTEX FLOW TO A BIPHASE LIQUID GAS MIXTURE. Cl. Moussez (Société Nationale d'Étude et de Construction de Moteurs d'Aviation, Suresnes, France).

Improvement of heat transfer in boiling-water reactors by means of the vortex flow principle is being studied. The compatibility of an assembly of associated unit vortex flows induced by twisted tapes is being investigated. The path followed by and the distribution of the air-water mixture are shown for preliminary tests along with the hydrodynamic compatibility of the unit vortices. Void fraction correlations and the biphase pressure loss factor were obtained in thermodynamic tests. Results are shown in graphs. (M.C.G.)

20182 (TID-7694(p.108-49)) SUMMARY OF A RESEARCH PROGRAM IN TWO-PHASE FLOW IN PROGRESS AT CISE. Pr. M. Silvestri (Centro Informazioni Studi Esperienze, Milan).

Work on two-phase flow and related problems in connection with nuclear reactor cooling and experiments on two-phase flow hydrodynamics and heat transfer are described. Corrosion and in-pile experiments are discussed. Equipment is shown in pictures and diagrams and results are presented in graph form. (M.C.G.)

20183 (TID-18835) TEMPERATURE ANALYSIS OF EMITTERS FOR ELECTRON HEATING. Robert E. Holtz (Argonne National Lab., Ill.). Feb. 1963. Contract [W-31-109-eng-38]. 13p.

The temperature distribution of emitters for use in electron heating of a liquid metal loop is analyzed. The temperature appears essentially constant over 78 to 85% of the cathode for several of the more severe conditions expected in an electron heating system. The uniform cathode temperature predicted verifies the uniform heat fluxes expected. (auth)

20184 A HEAT TRANSFER PROBLEM IN A HOLLOW CYLINDRICAL CELL. A. Belleni-Morante (Università, Florence). Energia Nucl. (Milan), 11: 134-6(Mar. 1964).

The steady and time-dependent temperature distribution in a hollow cylindrical solid cooled internally by means of a circulating fluid and insulated externally was studied, assuming a z-dependent heat source and a radial heat transmission. It was found that a change of the inlet fluid temperature produces a perturbation which propagates in the coolant and in the solid with a velocity equal to the coolant mean velocity. (auth)

20185 ANALYTICAL STUDY OF HEAT TRANSFER TO LIQUID METALS IN CROSS-FLOW THROUGH ROD BUNDLES. Chia-jung Hsu (Brookhaven National Lab., Upton, N. Y.). Intern. J. Heat Mass Transfer, 7: 431-46(Apr. 1964). (BNL-7053)

Improved theoretical expressions for Nusselt numbers were obtained for cross flow of liquid metals through rod bundles, by applying inviscid flow analysis. The theoretical derivations are based upon the assumption that, for a rod located in the interior of a bundle, the circumferential variations of both the tube-wall temperature and the hydrodynamic potential can be expressed by cosine-type distributions. The former assumption is deduced from the experimental observations of others, under conditions where the heat flux was apparently close to uniform, and the latter is postulated on the basis of theoretical considerations. With these assumptions, the following expression for the Nusselt number becomes $Nu_t = 0.958\,(\phi_1/D)^{1/4}(Pe)^{1/4}v_{max}\,(V/V_{max})^{1/4}$. A theoretical method of determining values of the parameter, ϕ_1/D, the normalized hydrodynamic potential drop, is also presented. An analytical expression for ϕ_1/D was obtained. The theoretical values of ϕ_1/D for flow across two typical tube-bank geometries,

i.e. square spacing and triangular equilateral spacing, were obtained with the aid of a high-speed digital computer. The numerical results are tabulated. (auth)

20186 BILATERAL HEAT TRANSFER IN ANNULI FOR SLUG AND LAMINAR FLOWS. O. E. Dwyer (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 19: 48-57(May 1964). (BNL-7117)

Nusselt numbers were calculated for bilateral heat transfer to fluids flowing in annuli. The following four cases were treated: (A) uniform and equal heat fluxes from both walls, under the condition of slug flow; (B) equal wall temperatures at the same axial location and uniform but unequal heat fluxes from the walls, under the condition of slug flow; (C) same as case (A), except flow is laminar; and (D) same as (B), except flow is laminar. In the calculations, the following assumptions were made: (a) the conditions of fully established velocity and temperature profiles, and (b) the independence of physical properties with temperature variation across the flow channel. The Nusselt numbers, independent of Reynolds and Peclet numbers, are given as functions of the geometrical parameter, r_1/r_2, which varied from zero to unity, the former limit representing the case of a round pipe and the latter that of parallel plates. For case (A), the heat-transfer coefficient for the heat transferred from the inner wall becomes infinite at $r_1/r_2 = 0.214$ because the inner wall surface temperature and the bulk temperature of the flowing fluid are equal under these conditions. For case (C), this happens at $r_1/r_2 = 0.1685$. The differences in Nusselt numbers between cases (A) and (B), and between cases (C) and (D), are appreciable, attaining maxima around $r_1/r_2 = 0.20$. At $r_1/r_2 = 1$, cases (A) and (B), of course, become identical, as do cases (C) and (D). Equations are given for calculating heat transfer coefficients for each wall, for the general case where the heat fluxes from the annulus walls are uniform but not necessarily equal. (auth)

20187 NEW THEORY OF THERMAL STABILITY IN BOILING SYSTEMS. Eugene F. Adiutori (Stability Consultants, Cincinnati). Nucleonics, 22: No. 5, 92; 94; 96; 98-101(May 1964).

The development of a quantitative theory for thermal stability in boiling systems is outlined. Burnout is described quantitatively. The theory has practical implications for design of liquid-cooled reactors and of boiling systems in the nuclear field. Its application to design of once-through-liquid-metal boilers is demonstrated. Boiling-heat-transfer coefficients are realized to be unhelpful in boiler design; it is suggested that boiling data be reanalyzed to correlate heat flux as a function of thermal driving force. (M.J.T.)

20188 MEASUREMENT OF THE FLOW VELOCITY OF HEATED GASES BY MEANS OF SPARK PHOTOGRAPHING. I. A. Vasileva and P. A. Sofronov (All-Union Inst. of Electronics, USSR). Pribory i Tekhn. Eksperim., No. 1, 190-3(Jan.-Feb. 1964). (In Russian)

A method is described for measuring the flow velocity of high temperature gases. The method consists in the excitation of a spark in the gas flow and detecting the motion of this spark by means of a mirror. The spark image is registered on a photographic plate. (tr-auth)

20189 MECHANISM OF MASS TRANSFER FROM GAS BUBBLES. Pang-sheng Li (Hwa-Tung Inst. of Chemical Tech., Shanghai). Sci. Sinica (Peking), 13: 499-513(Mar. 1964).

Liquid phase mass transfer coefficients were determined for streams of bubbles in water. The gases used were pure oxygen, 10% carbon dioxide in air, and 10% chlorine in air. Allowance was made for the effect of bubble distortion on mass transfer area. The results are compared with coefficients predicted by Higbie's equation for unsteady-state diffusion into transient films. The film life is taken as the time for a bubble to rise through its minor axis relative to the surrounding liquid. The observed coefficients for all three gases are slightly higher than predicted if the chlorine data are interpreted on the assumption of negligible hydrolysis within the transient water films. (auth)

20190 ANALYSIS OF EXPERIMENTAL DATA ON CRITICAL HEAT FLUX IN FORCED WATER FLOW. B. A. Zenkevich. Teploenergetika, No. 3, 86-8(Mar. 1964). (In Russian)

Data on q_{crit} at 30 to 200 atm pressures in forced water flow with parameters corresponding to saturation were analyzed. Experimental points expressed as velocity functions, $q_{crit} = f(W)$, indicate an ambiguous velocity effect. Diagrams of q_{crit} as a function of mean velocity and as a function of pressure at constant flow are constructed, and a formula was developed. (R.V.J.)

20191 THE STABILITY OF DISSIPATIVE COUETTE FLOW BETWEEN ROTATING CYLINDERS IN THE PRESENCE OF AN AXIAL MAGNETIC FIELD. Ulrich H. Kurzweg (United Aircraft Corp., East Hartford, Conn.). Z. Angew. Math. Phys., 15: 39-45(1964).

Niblett's analysis of the effect of an axial magnetic field on the stability of Couette flow between concentric rotating cylinders, assuming that the cylinders are insulators, was extended to the case where the cylinders have an arbitrary rotation ratio. An explicit evaluation is given for the critical Taylor and wave numbers as a function of the Hartmann number for all rotation ratios $|m| \leq 1$, where $m = \Omega_2/\Omega_1$ with Ω_1 and Ω_2 denoting the angular velocity of the inner and outer cylinder, respectively. (M.C.G.)

20192 THE SELECTION OF LIQUID METALS IN REACTOR TECHNOLOGY. K. Kummerer (Kernforschungszentrums, Karlsruhe, Ger.). 28p. (CONF-467-6)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

It is shown that, from all the liquid metals, it is sodium (and its alloys) that best fits the postulates of modern reactor technology. Beginning with the composition and discussion of the points of view for the selection of liquid metals these selection rules are applied to a large number of metals and alloys having a sufficiently low melting point. Because of the nuclear properties, the heat transport phenomena, the chemical and corrosion behavior, and the economic situation, only a few metallic liquids remain that are applicable to real heat transfer problems. After a summary of all the important properties the attempt is made to establish a range of applicability for these remaining metals. (auth)

20193 ON THE BURNOUT PROBLEM OF LIQUID METALS AT HIGH TEMPERATURES. W. Mialki (Technische Universität, Berlin). 15p. (CONF-467-7)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

The dependable prediction of the burnout heat flux, the so-called critical heat flux, for liquid sodium is discussed with respect to calculations and design of reactor systems. (C.E.S.)

20194 SOME PRACTICAL ASPECTS OF SODIUM SYSTEM RELIABILITY. Gordon D. Collins and W. J. Hallett (CEA, Cadarache, France). 7p. (CONF-467-3)

From European Atomic Energy Society Symposium

on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

Gas entrainment problems, structural problems, pumping systems, and instrumentation for the reliable performance of sodium coolant systems are discussed. (C.E.S.)

Materials Testing

20195 (SC-DC-64-383) A STUDY OF IMPACT EFFECTS ON SPHERICAL SHELLS. Quarterly Progress Report No. 1, November 1, 1963 to February 1, 1964. Charles E. Stoneking (Sandia Corp., Albuquerque, N. Mex.). Contract AT(29-1)-789. 7p.

A proposal is presented for investigating the structural integrity of hollow spheres when they are impacted against a rigid target of known properties. Preliminary design of an air gun to generate the required velocities is presented. (N.W.R.)

20196 (UCRL-7326) HIGH-TEMPERATURE DYNAMIC MODULUS MEASUREMENTS BY USE OF ULTRASONICS. H. L. Dunegan (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 6, 1962. Contract W-7405-eng-48. 29p.

A new technique is presented for measuring velocity of ultrasonic waves in isotropic solids at temperatures to 1600°F. A unique feature of the technique is that the specimen design allows both longitudinal and shear velocity data to be obtained with one transducer by virtue of using a mode conversion principle. A detailed description of the theory, specimen preparation, instrumentation, and experimental procedure are given along some experimental results of the variation of Young's modulus, shear modulus, and Poisson's ratio in hafnium, 4340, and Hastelloy "C" to temperatures of 1600°F. (auth)

Protective Structures

20197 (NAVDOCKS-P-310) PLANNING DUAL-USE MILITARY SHELTERS. (Bureau of Yards and Docks). Dec. 1963. 29p.

The inclusion in new military buildings of features that will make them readily convertible to fallout shelters in case of nuclear attack is discussed. Information is presented to enable architects to plan such dual-use military structures. Illustrative drawings and design specifications are included. The shelters are planned to be built in conventional spaces, without loss of functional efficiency, and with little or no additional cost. The specific military buildings selected to illustrate the planning analysis and concepts include enlisted men's barracks, training schools, administration buildings, 100-bed hospitals, subsistence buildings, and communications buildings. (C.H.)

Vacuum Engineering

20198 MAGNETIC-IONIZATION MANOMETER WITH HIGH SENSITIVITY. A. T. Lepekhin and A. M. Shereshevskii (Inst. for Analytical Instrumentation, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 151-6(Jan.-Feb. 1964). (In Russian)

The operation principles and construction of a magnetic-ionization instrument with a cold cathode for measuring the pressure of gas or vapor in the region 10^{-9} to 10^{-4} torr are described. Experimental performance and the basic parameters of the instrument are discussed. The sensitivity of the instrument is stable and is ~8 amp/torr. (tr-auth)

20199 IMPROVEMENTS IN AND RELATING TO VALVES FOR ISOLATING HIGH VACUUM CHAMBERS. Yoshiaki Arata and Masao Yamazoe. British Patent 954,954. Apr. 8, 1964. Priority date Apr. 5, 1961, Japan

A high vacuum valve is designed which has a long life and can be used repeatedly. In closing the valve, an electric heater is used to melt indium metal in an annular trough in the valve seat, the valve body is inserted into the liquid indium, and cooling water is passed through the body to solidify the indium and thus make a super airtight seal. The operation can be reversed to open the valve. The valve can be easily adapted for remote control. (D.L.C.)

GEOLOGY AND MINERALOGY

General

20200 (ARA-1054) ON-SITE SELF-POTENTIAL AND RESISTIVITY MEASUREMENTS. HARDHAT EVENT OF PROJECT NOUGAT. Arnold Glaser and Robert Kruszyna (Allied Research Associates, Inc., Boston). Apr. 20, 1962. Contract AF49(638)-1101. 39p.

The time variation of the self-potentials of the earth's surface and of earth resistivity resulting from an underground detonation of a nuclear device was measured during the Hardhat event of Project Nougat at the Nevada Test Site. With the use of non-polarizing electrodes, self-potential was monitored during the period D−7 days to D+7 days. In the immediate vicinity of surface ground zero the measured potential rose sharply in the 36 hours immediately after T = 0 to a maximum of about 35 millivolts above ambient. This potential rise was followed by an equally rapid fall-off in the next 24 hours to a new "ambient" level of about 10 to 20 millivolts above the pre-shot value. The resistivity measurements indicated a correlation between the shot location and changes in the electrical properties of the surrounding medium. Evaluation indicates that a deep underground nuclear explosion produces effects that can be observed at the earth's surface, and, therefore, may be a means for on-site location of a clandestine underground test. (auth)

20201 (NP-13867) SEISMIC DATA SUMMARY. NUCLEAR DETONATION PROGRAM, 1961 THROUGH 1963. W. V. Mickey and T. R. Shugart (Coast and Geodetic Survey, Washington, D. C.). Jan. 1964. 52p.

A summary is presented of the participation of the Seismology Division of the Coast and Geodetic Survey in the NOUGAT, STORAX, and NIBLICK nuclear detonation series from Sept. 15, 1961, Event Antler to Sept. 13, 1963, Event Bilby. Digital computer analysis techniques and particle trajectories are also discussed. (D.L.C.)

20202 RARE-EARTH DISTRIBUTION PATTERNS IN EIGHT TERRESTRIAL MATERIALS. Allan Schofield and Larry Haskin (Univ. of Wisconsin, Madison). Geochim. Cosmochim. Acta, 28: 437-46(Apr. 1964).

The rare earth element contents and relative abundances in a phosphorite, two coals, a composite mixture of sea shells, two corals, and two carbonatites were determined by neutron activation analysis. The abundance distribution patterns in the phosphorites and calcareous marine materials are close to that of well-differentiated sediments. The coals are extra-abundant in Eu and depleted in the heavier and lighter lanthanides, relative to sediments. The distributions in the carbonatites resemble each other, but vary quite markedly from the sediment pattern, as is characteristic of most other materials with igneous origins. Considerable latitude was found in the rare earth concentrations. The La content of the phosphorite was 160 ppm; of the coals 4.9 and 3.3 ppm; of the shells and corals 0.13, 0.08, and 0.052 ppm; and of the carbonatites 181 and 76 ppm. (auth)

20203 GAS SOURCE MASS SPECTROMETRY OF TRACE LEADS FROM SUDBURY, ONTARIO. T. J. Ulrych and R. D. Russell (Univ. of British Columbia, Vancouver). Geochim. Cosmochim. Acta, 28: 455-69(Apr. 1964).

A free radical technique for the preparation of lead tetramethyl is described that has reduced by a substantial amount the sample size necessary for a precise gas source analysis. In this way, the range of minerals that may be studied by means of a gas source mass spectrometer has been greatly extended. The free radical method was applied to the study of lead isotope abundance variations in the mining district of Sudbury, Ontario. The analysis of lead from various sulfides yielded lead isotope ratios that are linearly related on a plot of $^{207}Pb/^{204}Pb$ vs $^{206}Pb/^{204}Pb$ with a slope of 0.131 ± 0.003; the standard deviation of points from their best straight line is 0.37% of the average $^{207}Pb/^{204}Pb$ value. (The intercomparison technique previously used to determine the ratios of ordinary leads was not used for these analyses.) It was concluded that the linear relationship is the result of just two geological events, which fact simplifies the possible interpretations. The maximum times of these two events are 2150 ± 50 m.y. and 1280 ± 50 m.y., respectively. Two interpretations of the results are suggested. The first gives ages of 1950 and 350 m.y. for the primary and secondary events. The two events in the second interpretation are considered to have occurred 1600 and 950 m.y. ag. The second interpretation is more easily defended on geological grounds. (auth)

20204 THE RELATIVE PRODUCTION CROSS SECTIONS FOR ^{3}He AND ^{21}Ne FROM Mg, Si, S, AND Fe IN STONE METEORITES. H. Hintenberger, H. Koenig, L. Schultz, H. Waenke, and F. Wlotzka (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 19a: 88-92(Jan. 1964). (In German)

With various mineral separation methods, including the technique of specific solvents, very pure fractions of metallic iron, troilite, olivine, and pyroxene were separated from the Holbrook meteorite. Helium and neon were extracted from those minerals. The measurements allowed a determination of the relative production rates of ^{3}He and the neon isotopes by cosmic rays in iron, sulfur, magnesium, and silicon. The results enable the relative production rates of these isotopes in all kinds of meteorites whatever their chemical composition to be calculated. The ratio of the relative production rate of ^{21}Ne from Mg and Si was 1.8 ± 0.4. Therefore, it was concluded that the variations of the $^{3}He/^{21}Ne$ ratio in stone meteorites can not be explained by variations in their chemical compositions, at least not for the normal chondrites. (auth)

20205 HELIUM AND NEON ISOTOPES IN IRON METEORITES. H. Hintenberger and H. Waenke (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 19a: 210-18 (Feb. 1964). (In German)

The helium and neon content of 22 iron meteorites as well as the isotopic compositions of the rare gases were measured. Definite relations were found between the amounts of the cosmic-ray-produced isotopes ^{3}He, ^{4}He, and ^{21}Ne and also for their ratios. A rough correlation between the mass of the meteorite and the "depth" of the sample was found; a correlation for the $^{3}He/^{4}He$ and the $^{4}He/^{21}Ne$ ratios also exists. The following relationship holds for 19 of the 21 meteorites: $^{3}He/^{4}He = 0.166 + 174\ (\Sigma\ Ne/\Sigma\ He) \pm 0.018$. The only exceptions are the meteorites Braunau and Colomera. Because these exceptions only show up in diagrams in which the values for ^{3}He are included, it was assumed that both these meteorites, as well as perhaps also the meteorite Morradal, lost part of their ^{3}He. This might be explained by a diffusive loss of tritium during times of higher temperatures of the meteoritic bodies, probably due to a closer approach of these meteorites to the sun. (auth)

20206 ON THE QUESTION OF DIFFUSION LOSS OF RADIOGENIC AND SPALLOGENIC RARE GASES FROM STONE METEORITES. H. Hintenberger, E. Vilcsek, and H. Waenke (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 19a: 219-24(Feb. 1964). (In German)

Using a technique of specific solvents the rare gas contents of the main mineral fractions of stone meteorites were measured separately. In this way the diffusion loss of the radiogenic and spallogenic rare gases in 5 chondrites all of which had U-Th-He ages considerably below 4.5 billion years was studied. The results showed that in 4 of these meteorites all of which belonged to the Urey–Craig group L, no diffusion losses occurred during the time of cosmic ray exposure. Only in one of the meteorites, i.e. Breitscheid, (group H) large diffusion losses of the cosmic-ray-produced ^{3}He were found. Considerable losses of radiogenic ^{4}He could be proved for the meteorites Breitscheid and Bruderheim. For the meteorite Breitscheid the loss of ^{4}He seemed to be approximately a factor of 2 lower than that of ^{3}He. (auth)

20207 PROGRESS IN ISOTOPE GEOLOGY. Kalervo Rankama. New York, Interscience Publishers, 1963. 719p. $20.00.

Information is included on: atoms, nuclei, and nuclides; isotopy; mass analysis; radioactivity; applications of radioactivity to geoscience; nuclear reactions in nature; abundance and formation of elements and nuclides; and nuclides in nature from hydrogen to nobelium with the exceptions of Cu, Rh, and Po. Numerical constants and conversion factors, table of atomic weights for 1957, the system of nuclides, and the periodic system are appended. Approximately 1645 references are included for the period 1954–57. (P.C.H.)

Natural Radioactivity and Fallout

Refer also to abstracts 20231, 20232, 20234, and 20237.

20208 (AERE-R-4415) DISTRICT BIOLOGICAL MONITORING AT A.E.R.E., HARWELL. RESULTS FOR 1961 AND 1962. H. D. Vandervell, G. R. Mitchell, and A. Morgan (United Kingdom AtomicEnergy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Mar. 1964. 26p.

The district biological monitoring program at A.E.R.E., Harwell, was modified in July, 1961. The results of measurements made during 1961 and 1962 in accordance with the revised program are described. Levels of ^{90}Sr and ^{137}Cs in milk, sampled at seven farms within three miles of A.E.R.E., were no greater than would be expected from worldwide fallout and are only about 1% of the derived working limits appropriate for members of the public living in the neighborhood of controlled areas. Levels of ^{131}I in milk from local farms were consistently below the minimum detectable level (15 pC/l) except after nuclear weapons testing in the late summer and autumn of 1961 and 1962. On these occasions concentrations were comparable with independent measurements made elsewhere in the south and southeast England. Measurements of ^{90}Sr in soil, mat, and herbage collected at nine sites within 3 miles of A.E.R.E. were in good agreement with independent measurements made in other regions of comparable rainfall. Determinations of ^{90}Sr in drinking-water supplies derived from the River Thames at Oxford and London show that radioactive effluent discharged from A.E.R.E. into the Thames very slightly enhanced the concentration of this radionuclide above the level which would be expected from fallout alone. This increase represents only a fraction of 1% of the permissible concentration (taken as $\frac{1}{30}$th of the MPC_w recommended by the International Commission of Radiological Protection for 168 hr/week exposure). Measurements of ^{137}Cs in the same supplies showed a greater enhancement, but expressed in terms of the permissible value, the increase has even less significance. (auth)

20209 (CEA-2397) MESURES QUOTIDIENNES DE LA RADIOACTIVITE ATMOSPHERIQUE A LONGUE PERIODE SUR LES PRINCIPAUX SITES NUCLEAIRES FRANCAIS EN 1961 ET 1962. (Daily Measurements of the Long Half-Life Atmospheric Radioactivity on the Main French Nuclear Sites During 1961 and 1962). A. Doury (France. Commissariat a l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1963. 64p.

Data are tabulated on β radioactivity of air and precipitation at French nuclear reactor sites during 1961 and 1962. (C.H.)

20210 (CLOR-20) THE GAMMA RADIOACTIVITY OF BUILDING MATERIALS FOR THE CONSTRUCTION OF LOW-BACKGROUND LABORATORIES. J. Pensko and M. Bysiek (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1963. 59p.

The natural gamma radioactivity of over 200 samples of commonly used building materials was determined. Some spectrometric measurements were performed. The measurements were carried out in order to determine the appropriateness of some building materials to the construction of low-background laboratories. As a result of measurements, it can be found that blast-furnace slag, boiler furnace slag, granite, and fly-ashes possess rather high gamma radioactivity. Such building materials as gravel, common cement, concrete, sand, mortar, gypsum, lime, chalk, aggregate, sandstone, limestone, marble, anhydryte, and rock salt possess in comparison to above mentioned materials a lower degree of gamma radioactivity. The approximate assessment of doses which might be absorbed by inhabitants of various types of houses from this source of radiation showed that they remain within limits of average background of radiation which is observed in various typical regions of the world. (auth)

20211 (CLOR-24) RADIOAKTYWNOSC WOD W POLSCE W 1962 ROKU. (Radioactivity of Water in Poland in 1962). St. Wlodek and D. Grzybowska (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1963. 19p.

Data are presented on the β radioactivity of 358 water samples collected throughout Poland during 1962. It was estimated that water radioactivity was directly proportional to river levels and inversely proportional to the temperature of the water. Data on gross β activity of samples collected from 1958 through 1962 are compared. (C.H.)

20212 (NP-13846) RADIOACTIVITY FROM NUCLEAR WEAPONS TEST IN AIR AND PRECIPITATION IN SWEDEN 1963. G. Lindblom (Sweden. Forsvarets Forskningsanstalt, Stockholm). Apr. 1964. 13p.

Fallout measurements of 1963, a year of no atmospheric testing of nuclear weapons, were compared to results from 1959 and 1962. A correlation was found with the assumed relative fission yields of the Arctic test series of 1958, 1961, and 1962, respectively. (auth)

20213 STRONTIUM-90 AND CESIUM-137 IN PLANTS AND ANIMALS IN FINNISH LAPLAND DURING 1960. O. Paakkola and J. K. Miettinen (Univ. of Helsinki and Biochemical Inst., Helsinki). Ann. Acad. Sci. Fennicae, Ser. A, II, 125: 1-14(1963).

Strontium-90 and ^{137}Cs in folder plants and in the tissues of reindeer and cow were analyzed from samples collected in Lapland during 1960. Reindeer lichens contained 4 to 15 nC ^{90}Sr and 20 to 60 nC ^{137}Cs/kg of dry weight, while sedges contained about one-tenth of the above values, the other grass plants even less. Reindeer meat contained 30 to 50 nC ^{137}Cs/kg fresh weight, cow's meat 0.8 nC. Other soft tissues of reindeer contained one-half to one-fourth of the ^{137}Cs content in meat. Cow's milk contained in winter 15, in summer 9 pC ^{90}Sr/g Ca while reindeer milk contained 60 pC/g Ca in summer. On the basis of the analytical results, the observed ratios, nC ^{90}Sr/g Ca, in tissue/in diet in different tissues of reindeer were calculated. (auth)

20214 LEUKEMIA AND BACKGROUND RADIATION IN NORTHERN NEW ENGLAND. Ascher Segall (Harvard Univ., Boston). Blood, 23: 250-61(Feb. 1964).

A survey of background radiation and mortality from leukemia was conducted in the states of Maine, New Hampshire, and Vermont. The radioactivity in bedrock underlying each of 1,178 minor civil divisions was estimated on the basis of radiogeological analysis. Values were found to range from 5 ppm equivalent U in the limestone areas of Vermont to 45 ppm equivalent U in the Conway granite region of New Hampshire. Mortality records from the tri-state study area for the period 1925–54 were examined. One thousand nine hundred seventy deaths from leukemia were identified and tabulated by minor civil division. An expected number of deaths by decade was calculated for each minor civil division using the tri-state age specific rates for standardization. Minor civil divisions were grouped into four categories according to mean equivalent U concentration in underlying bedrock. The difference in annual dose rate from external background sources was estimated to be 14.65 mrads/yr. No significant difference in exposure to internal emitters was noted. The observed and expected numbers of deaths were compared within each of the four radiogeological categories. No statistically significant association was observed between mortality from leukemia and radiogeological category either for the entire 30-yr study period or within successive decades. These data do not allow rejection of the hypothesis that leukemia mortality varies with background radioactivity if the dose response relation is of the order of that estimated from studies in humans at doses of 100 rads or greater. It seems unlikely that such a hypothesis could be adequately tested in the United States where geographic variation in background radiation is relatively small. (auth)

20215 RADIOCHEMICAL FALLOUT STUDY OF A PACIFIC CYCLONIC STORM. Paul Kruger and Albert Miller (Hazleton-Nuclear Science Corp., Palo Alto, Calif.). J. Geophys. Res., 69: 1469-80(Apr. 15, 1964).

A meteorological analysis of the storm that occurred on February 7, 1962, at Santa Barbara, California, was made in conjunction with radiochemical analysis of precipitation collected continuously at altitudes of sea level, 600 m, and 1200 m. The sampling period included the approach toward the coast and passage of one wave and the approach of a second wave. The three altitudes exhibited similar ^{90}Sr deposition patterns. Concentrations ranged from over 100 dpm/l to less than 1 dpm/l, with several changes of more than a factor of 10 within hourly periods. The large variations of ^{90}Sr concentration in the precipitation at the three altitudes may be linked to atmospheric changes during the storm. Such effects as saturation of the lower layers of air, overturning of the marine layer, approaches of the frontal and upper trough zones, vertical growth of the cloud system up to the tropopause, and incursions of high-level layers of dry air may explain the observed changes in fallout rate during the storm. (auth)

20216 Sr^{87}/Sr^{86} RATIOS IN HAWAIIAN LAVAS. Peter Lessing (Southwest Center for Advanced Studies, Dallas) and E. J. Catanzaro. J. Geophys. Res., 69: 1599-1601 (Apr. 15, 1964).

The $^{87}Sr/^{86}Sr$ ratios were determined for 15 Hawaiian lavas, which are members of the tholeiitic and alkaline series. There is a consistent inverse relation between the $^{87}Sr/^{86}Sr$ ratio and the K/Rb ratio. This suggests that contamination by assimilation of marine sediments is an influencing factor in Hawaiian petrogenesis. (auth)

20217 SEARCH FOR NATURAL CURIUM 247. G. W. Wetherill (Univ. of California, Los Angeles), W. F. Libby, and G. W. Barton. J. Geophys. Res., 69: 1603-5(Apr. 15, 1964).

A sample of rare-earth concentrate derived from euxenite was analyzed for the long-lived isotope ^{247}Cm by mass spectrometric isotope dilution. Less than 10^{-14} g of ^{247}Cm per gram of rare earth was found. It is difficult to reconcile this negative result with the reported discovery of this isotope in nature. (auth)

20218 THE MONITORING OF WATERS AND SOIL FOR RADIOACTIVITY. O. Jaag (Technische Hochschule, Zurich). Oncologia, 16: 230-44(1963). (In German)

Methods of measuring radioactivity, the range of the Swiss monitoring network, and the trend of the measured values for air, precipitation, surface water, drinking water, fish, water plants, river sediments, soil, hay, and grass since 1956 are reviewed. The possibilities of decontamination, especially for cistern drinking water, are discussed. An apparatus is described, which proved to be suitable for the purification of small amounts of radioactive water. (M.C.G.)

20219 RADIOACTIVE PARTICLE IN SEDIMENT FROM THE COLUMBIA RIVER. Norman Cutshall and Charles Osterberg (Oregon State Univ., Corvallis). Science, 144: 536-7(May 1, 1964).

A hot particle containing only fission product radioactivity and comprised of a number of characteristics that make it unusual and its origin uncertain was found in the Columbia River. (auth)

20220 VARIATION OF CESIUM IN THE OCEAN. T. R. Folsom (Scripps Institution of Oceanography, La Jolla, Calif.), C. Feldman, and T. C. Rains. Science, 144: 538-9(May 1, 1964).

Samples of sea water from several oceans and several depths were analyzed for natural cesium by flame photometry with precision of about 3.5%. The average of 16 assays of surface water from four oceans was 0.37 microgram per liter, somewhat less than the average previously reported. The average cesium concentration in samples taken between 500 and 1500 meters was about 14% higher than the surface average, suggesting that cesium may be transported downward by particulate material. Natural cesium is now somewhat easier to study in the ocean than radiocesium from fallout is, and information on one complements the other. (auth)

20221 THE DETERMINATION OF THE LONG-LIVED NUCLIDES Cl^{36}, Al^{26}, AND Be^{10} AS REACTION PRODUCTS OF COSMIC RADIATION IN IRON METEORITES AND STUDIES OF THE DETERMINATION OF RADIATION AND EARTH AGE. F. Sammet. Thesis, Cologne, Universität, 1963. 98p. $2.00(Gmelin, AED-DISS. 63-312). (In German)

Methods for radiochemical preparation of meteorite samples for counting of the long-lived nuclides ^{36}Cl, ^{26}Al, and ^{10}Be are given. An anticoincidence arrangement was used for counting. Calibration procedures are described. Absolute disintegration rates for 8 meteorites are given. Four of these have a radiation age of 4×10^8 y. The disintegration rate varies approximately inversely to meteorite mass. Related production rates are calculated. (Gmelin Inst.)

20222 THE RADIOACTIVITY, SITES OF ALPHA EMITTERS, AND RADIOACTIVE DISEQUILIBRIUM IN THE CONWAY GRANITE OF NEW HAMPSHIRE. Keith Allan Richardson. Thesis, Houston, Tex., Rice Univ., 1963. 98p.

The radioactivity of the Conway granite of New Hampshire was studied by γ-ray spectrometry, autoradiography, and α-particle pulse-height analysis, as part of an investigation of the possibility of recovering Th from common rocks. It was concluded that the Conway granite is homogeneous with respect to Th, and the mean Th concentration in the Conway granite of the White Mountain batholith is 56 ± 6 ppm. On this basis, the Conway granite in the White Mountain batholith is considered a low-grade Th resource containing 3 million tons of Th per hundred feet of depth. Comparison of Th and U concentrations in drill-core samples and in samples taken from outcrops indicates an average U loss of 35% from surface samples of Conway granite. Autoradiographic results show that ~⅔ of the α emitters in the Conway granite are concentrated in accessory mineral grains identified as thorite, huttonite, allanite, and zircon. The wide ranges of α activity and the estimated Th concentrations in zircon, thorite, and huttonite suggest that extensive isomorphism exists between zircon and thorite, and that the mineral identified as huttonite is isomorphous between monazite and huttonite. Radioactive disequilibrium in the U-238 series was found in extremely weathered rock, with a U-234 deficiency of about 50%. Other samples taken from deeper in the drill core and from other outcrops showed an equilibrium ratio between U-238 and U-234. (Dissertation Abstr., 24: No. 8, Feb.(1964))

Techniques and Equipment

20223 DATING OF HUMUS PODZOLS BY RESIDUAL RADIOCARBON ACTIVITY. R. M. S. Perrin (Univ. of Cambridge, Eng.), E. H. Willis, and C. A. H. Hodge. Nature, 202: 165-6(Apr. 11, 1964).

Dating studies were made on two examples each of the Brandon and Santon Series of podzols using ^{14}C. The samples were selected from sites where the elevation and the morphology of the profiles suggested that there had been no ground-water influence or development of peat at any stage. The data show that, while reasonable reproducibility is obtained for duplicate samples from the same profile, there are no systematic differences in apparent age between the well developed (Brandon Series) and less well developed (Santon Series) podzols. The magnitude of the apparent ages, however, confirmed the initial assumption that the B horizons are biologically fairly inert. Also, it shows with certainty that podzolization commenced in these soils at least as early as 2860 B.P. (P.C.H.)

20224 FISSION DAMAGE IN CALCITE AND THE DATING OF CARBONATES. Robert F. Sippel and Everett D. Glover (Socony Mobil Oil Co., Dallas). Science, 144: 409-11(Apr. 24, 1964).

Fission damage induced in calcite is shown by etch pits developed with weak acid at the damage sites. The damage can be differentiated from dislocations by annealing. By this method fossil fission damage in natural samples was observed. Thus, some etch pits previously attributed to dislocations actually result from such damage. Annealing studies indicate that the damage should persist for about 4×10^7 years at 50°C, and direct evidence suggests that the fission damage has persisted for at least 10^6 years in one specimen. (auth)

20225 TELEIZMERENIE RADIOAKTIVNYKH IZLUCHENI. (Telemetry of Radioactive Emissions). A. A. Bragin and V. I. Mikhailovskii. Kiev, Publishing House of the Academy of Sciences, 1963. 156p.

Applications of radiometric devices for well logging and telemetric techniques are analyzed. Means for improving the accuracy, efficiency, and thermal stability of drilling equipment are discussed, and methods for transmitting information on radioactive emissions are evaluated. (R.V.J.)

Thorium and Uranium Minerals

20226 (INSJ-67) SOME CONSEQUENCES FROM LEAD ISOTOPES IN NATURE. THE GENETIC NATURE AND SEAT OF THE SOURCE MATERIAL OF MAGMAS. Akimasa Masuda (Tokyo Univ. Inst. for Nuclear Study). Jan. 29, 1964. 20p.

The genetic relations between tholeiite, high-alumina basalt, and alkali olivine basalt, the depths of seats of their original source materials, the relation between the abundance ratios Th/Pb and U/Pb as seen from the isotopic composition of ore Pb, the source of Pb in ore minerals, and the isotopic composition of Pb in volcanic rocks are discussed. It is concluded that the high-alumina basalt of Japan is very close to the original material, the tholeiite is a material representing the solid phase separated from the melt like high-alumina basalt magma, and the alkali olivine basalt is the product of partial melting of the material resembling the high-alumina basalt. It is suggested that the material responsible for tholeiite of Japan was originally seated at 150 km, and that responsible for alkali olivine basalt at 340 km. The most frequent sources of the mother materials for Pb in ores were also estimated to be at 150 km under the earth's surface, and it is inferred that such sources are very rare below 400 km and above 75 km within the earth. (auth)

20227 A STUDY OF THE CORRELATION BETWEEN LANTHANIDES IN ORES. D. A. Mineev (Inst. of Mineralogy, Geochemistry, and Crystal Chemistry of Rare Elements, USSR). Dokl. Akad. Nauk SSSR, 154: 615-18 (Jan. 21, 1964). (In Russian)

A metasomatic deposit 320 m long and 10 m deep showed a high average content of Nb, Ta, Zr, TR (rare earths), U, Th, and Be(1.5 to 2.0 orders higher than the Clark number). The average composition of the lanthanides (with ΣLn = 100%) was as follows: $La_{4.5}$, $Ce_{18.0}$, $Pr_{3.0}$, $Nd_{8.6}$, $Sm_{4.6}$, $Eu_{0.5}$, $Gd_{6.0}$, $Tb_{1.5}$, $Dy_{15.5}$, $Ho_{4.2}$, $Er_{13.0}$, $Tu_{1.9}$, $Yb_{16.3}$, $Lu_{2.5}$. The yttrium content on the average was about ⅔ and the ΣLn was ⅓ of the ΣTR_2O_3 (rare earth oxides). Correlation coefficients are given for the contents of even and odd,

neighboring, rare earths. The results on 45 samples show that the lanthanides can be separated into the following correlated groups: 1) ΣCe = La + Ce + Pr + Nd (+Sm + Eu); 2) ΣGd = (Eu +) Gd; and 3) ΣEr = Lu + Yb + Tu + Er (+ Ho + Dy + Tb). (TTT)

20228 ALTERATION STUDIES AND URANIUM EMPLACEMENT NEAR MOAB, UTAH: PART I. HYDROTHERMAL ALTERATION ALONG THE LISBON VALLEY FAULT ZONE, SAN JUAN COUNTY, UTAH. PART II. ALTERATION STUDIES OF CUTLER AND CHINLE STRATA ALONG LISBON VALLEY ANTICLINE, SAN JUAN COUNTY, UTAH. PART III. A REVIEW OF LEAD/URANIUM AND SULPHUR ISOTOPE DATA FOR LISBON VALLEY, UTAH. PART IV. ALTERATION IN CUTLER STRATA ON THE CANE CREEK ANTICLINE, SAN JUAN COUNTY, UTAH. Marian Beckmann Jacobs. Thesis, New York, Columbia Univ., 1963. 244p.

In order to identify the mineralogical changes recorded in sediments from the passage of ore solutions, relevant specimens from Cutler and Chinle strata associated with uranium deposits on Lisbon Valley and Cane Creek anticlines were studied in detail. A major fault follows the crest of the Lisbon Valley salt anticline and strikes northwest across the Big Indian Wash uranium area. Solution activity in the fault zone is indicated by bleaching and silicification. Argillic mineral associations, fracture-controlled copper sulphide deposits, and indurated hydrocarbons indicate that the mineralizing solutions were heated. Bleaching near fractures and in porous Cutler strata on Lisbon Valley anticline, known locally as "sugar sands," is demonstrated to show solution movement through these strata. In sugar sands close to Lisbon Valley fault, feldspar and biotite are altered to kaolinite and biotite is replaced by interleaved lenses of calcite. The alteration is interpreted as the result of hydrothermal activity, which is marked by the work of diffusing solutions on selective minerals, often leaving them incompletely changed. Sugar sands southeast of the Lisbon Valley fault have a mixed-layer clay content, which represents an intermediate stage in the alteration of mica and chlorite to clay. It is suggested that the system of faults, fractures, and porous stratigraphic conduits extended laterally and vertically to distant reaches and provided ease of movement for mineralizing solutions. Available lead/uranium and sulfur isotope data for the Lisbon Valley uranium area, Utah, were reviewed from the standpoint of their bearing on interpretation of the mechanism of uranium emplacement. In Cane Creek area, several mineralized high angle faults closely parallel the northwest trending anticlinal axis, and are mineralized with uraninite, secondary uranium minerals, and associated organic material. Intense bleaching of red beds occurs near faults and fractures, and extends into adjoining strata. The fault-controlled uranium deposition is interpreted as having been caused by the reduction of uranium-bearing solutions by hydrogen sulfide derived in part from petroleum, which migrated upward along fractures, as well as from decaying organic material. Extensive activity of solutions along fractures is evident and suggests a motivating hydrothermal source, an aftermath of igneous intrusions known to penetrate the Plateau sediments, such as in the LaSal stocks and loccoliths. (Dissertation Abstr., 24: No. 9, March 1964)

HEALTH AND SAFETY

Refer also to abstracts 20209, 20212, and 20214.

20229 (CLOR-23) DECONTAMINATION FACTORS OF THE FILTRATION PLANT OF WARSAW CITY. R. Szepke, D. Grzybowska, B. Kolańczyk, Z. Błażewska, Z. Oszywa, and E. Trusewicz (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). 1963. 12p.

Presented are the results of decontamination factors of the Filtration Plant, Warsaw, investigated in the period of 1960–1962. All data obtained, including hydrological and hydrobiological characteristics of the Vistula River, are evaluated by statistical method and tabulated. The mean value of the decontamination factors obtained is 1.40. There are calculated also correlation factors between the decontamination factors and selected parameters of the Vistula River. (auth)

20230 (GAT-R-335) HEALTH AND SAFETY ACTIVITIES REPORT FOR 1963. (Goodyear Atomic Corp., Piketon, Ohio). Mar. 12, 1964. Contract AT(33-2)-1. 60p.

There are many safety precautions peculiar to atomic energy operations that are required by the Atomic Energy Commission and are found in the procedures at Goodyear Atomic Corp. Just as important as these special precautions are the many common precautions against hazards found in every industrial plant. Most of the responsibilities for the health and safety activities in conjunction with these precautions are distributed among several groups in the Industrial Relations Division. These groups are in the Medical Subdivision and the Safety and Fire Protection Subdivision. The more significant functions of these groups, as well as the more important statistics compiled during calendar year 1963, are reported. (C.H.)

20231 (HW-SA-3048) RADIOACTIVITY IN NORTHERN ALASKAN ESKIMOS AND THEIR FOODS, SUMMER 1962. W. C. Hanson, H. E. Palmer, and B. I. Griffin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [May 15, 1963]. Contract AT(45-1)-1350. 23p.

Radionuclide concentrations in the human inhabitants of northwestern Alaska were studied during the summer of 1962. A portable whole-body counter was used to examine 703 Eskimos and 78 non-native residents at four sites selected on the basis of location within the state, composition of the native population, and sources of native foods. Cesium-137 was the most important and often the only gamma-emitting fallout radionuclide detected in the subjects examined. Results of whole-body counting and dietary information obtained showed a clear relation between the amount of caribou and/or reindeer consumed and the ^{137}Cs body burden. Moose likewise was determined to be an important vector of ^{137}Cs among native human populations. The ^{137}Cs body burdens of the Eskimos examined were well within current recommended limits (NCRP 1959). Other fallout radionuclides detected during the study were ^{65}Zn and $^{95}Zr-^{95}Nb$, the ^{65}Zn being observed in individuals who had consumed appreciable quantities of oysters. (H.M.G.)

20232 (JAERI-1057) FALLOUT RADIOACTIVITY IN EXCRETA AND DIET—THE LEVELS AT TOKAI, JAPAN IN 1962 TO 1963. Minoru Fujita, Jun Akaishi, Akira Yabe, Junko Iwamoto, Yoshiko Ichikawa, Toshio Okamoto, and Hiroshi Fukuda (Japan Atomic Energy Research Inst., Tokyo). Dec. 1963. 37p.

The fallout levels of fission products such as ^{90}Sr, ^{137}Cs, ^{95}Zr, ^{95}Nb, ^{103}Ru, and ^{106}Ru, in excreta and diet were measured. In connection with ^{137}Cs and ^{90}Sr, the amounts of stable K and Ca in the same specimens were also analyzed. The volume and weight of the samples were examined to get the mean value and the range. The experiment started in May 1962 and ended in February 1963. During the period, seven samplings were made. In each sampling, excreta were collected over five consecutive days from five normal subjects, who, except one, received the same diet. An exact duplicate of the diet was analyzed at the same time. A large NaI(Tl) crystal scintillator and a 100-channel pulse-height analyzer were used to determine the radioactivities of γ emitters in ashed samples, while ^{90}Sr and ^{137}Cs were analyzed radiochemically. In general, the content of ^{95}Nb in the diet was highest among all the radionuclides, reaching about 60 $\mu\mu$C/day/person in February 1963. In urine samples, detectable amounts of ^{95}Zr, ^{95}Nb, ^{103}Ru, and ^{106}Ru were not found, in contrast with the considerable amounts in feces. The level of ^{90}Sr in the diet varied between 7.0 and 13 $\mu\mu$C/day/person during the period, and that of ^{137}Cs, between 13 and 35 $\mu\mu$C/day/person. However, in 24-hr urine samples, about 1 $\mu\mu$C of ^{90}Sr was always found irrespective of the contents in the diet. The activities of ^{137}Cs in the same urine specimens, however, changed between 10 and 31 $\mu\mu$C corresponding to the contents in the diet. The levels of ^{90}Sr, ^{137}Cs, and $^{95}Zr + ^{95}Nb$ involved in the diet varied during the period according to the changes of the dry fallout levels in the atmosphere. The average daily volume of urine for individuals was 950 to 1300 ml. (auth)

20233 (NP-13806) VULNERABILITY OF MUNICIPAL WATER FACILITIES TO RADIOACTIVE CONTAMINATION FROM NUCLEAR ATTACKS. Hong Lee (Stanford Research Inst., Menlo Park, Calif.). Mar. 1964. 53p.

In the event of a nuclear attack upon the United States, the surface source waters would become contaminated with radioactive nuclides carried by fallout particles. The absorbed dosage in the body tissues of humans resulting from drinking contaminated surface waters, especially after the water is processed in treatment plants, is not critical. In areas where heavy levels of fallout occur, the overriding hazard facing the survivors is external radiation. Contaminated water is a secondary problem facing survivors in the postattack environment. Also, a large proportion of the postattack population will have uncontaminated ground source water available, and, if this water is properly handled after it is drawn from wells, it will remain clean. (auth)

20234 (NP-13859) FALLOUT IN NEW ZEALAND. Quarterly Report, October–December 1963 and Summary for 1963. (New Zealand. National Radiation Lab., Christchurch). Mar. 13, 1964. 24p. (NRL-F11)

Data are presented on radioactivity due to fallout in samples of rain water, air, and soil collected in New Zealand during 1963. Results are included from measurements of ^{90}Sr in rain, milk, and human bone samples, and ^{137}Cs in milk. (C.H.)

20235 (NP-13868) SOME ASPECTS OF THE KINETICS OF Sr-90 ACCUMULATION IN THE BODY UNDER CONDITIONS OF CHRONIC INTAKE. Julian Liniecki

(Poland. Panstwowa Rada do Spraw Pokojowego Wykorzystania Energii Jadrowej, Warsaw). 1963. 51p.

Factors affecting the passage of ^{90}Sr through the food chain to man and hazards from the chronic inhalation or ingestion of atmospheric ^{90}Sr are reviewed. Procedures for calculating the maximum permissible concentration of ^{90}Sr for man are discussed. Four models of ^{90}Sr turnover in the skeleton of adults were applied in calculations of the skeletal burden under conditions of chronic daily intake of ^{90}Sr in amounts found in the diet from 1953 through 1961. Calculated and observed values were compared for the United States, New York City, Canada, the United Kingdom, and Poland. Measured values provided a fairly good fit with the power function model of Sr retention derived from ^{85}Sr studies in humans. A simplified model, based on the assumption that 2.5 to 3.5% of skeletal Ca is exchanged per year, also gave good agreement with observed values. Tentative values are given for the maximum permissible daily intake of ^{90}Sr for the constant exposure of adults. (C.H.)

20236 (PG-Report-565) HEALTH AND SAFETY RESEARCH AT CHAPELCROSS. Annual Report, 1963. J. H. Martin (United Kingdom Atomic Energy Authority. Production Group. Chapelcross Works, Annon, Dumfriesshire, Scotland). 1964. 6p.

Progress is reported in a search for biological indicators of radiation exposure and attempts to remove ^{85}Sr from rats by altering certain physiological parameters. The effectiveness of DTPA in removing ^{239}Pu from rats was demonstrated when the chelating agent was given 36 to 43 days after the isotope. Studies were made of the characteristics of the Solway Firth that might affect the marine discharge of radioactive wastes from the Chapelcross reactor and the distribution of various radioisotopes in the water and sediment of a cooling pond where fuel elements are stored after removal from the reactors. Investigations were also conducted on low-level counting methods, film badge filters, and neutron dosimetry. (C.H.)

20237 (USNRDL-TR-700) RADIOLOGICAL RECOVERY OF LAND TARGET COMPONENTS—COMPLEX III. W. L. Owen and J. D. Sartor (Naval Radiological Defense Lab., San Francisco). Nov. 20, 1963. 173p.

A special recovery planning procedure has been under development for several years. In its present form the procedural concept has proved quite feasible, as demonstrated by the results of the Complex II experiment. However, a number of critical planning variables and related factors have required closer inspection and measurement. For this reason the Complex III experiment was instituted. Some of the pertinent experimental results, leading to a more refined recovery planning procedure, are as follows: contribution factor calculations were confirmed by the experimentally determined values so that the resulting improved method of calculation is recommended for recovery planning purposes; reclamation coefficients (used in estimating recovery dose) appeared to vary with surface-method combination and effort and agreement with Complex II results were only approximate; final effectiveness in the reduction of the general radiation level by the combined action of weathering (by winds) and recovery was 97%, wind action accounting for approximately $\frac{1}{3}$ of the total reduction; total recovery time (or effort) predictions were low by approximately 10% because of the consistent trend in underestimating the times expected for individual reclamation jobs; at least $\frac{1}{5}$ of the total recovery time was devoted to support functions—those tasks not directly contributing to the dislodgement and removal of fallout material. (auth)

20238 (JPRS-24139) CHANGES IN THE STRONTIUM-90 CONTENT OF FOOD PRODUCTS AFTER COOKING. Z. V. Dubrovina and O. M. Belova. Translated from Gigiena i Sanit., No. 2, 40-3(Feb. 1964). 5p. (OTS-64-31050)

The passage of strontium-90 from bones, meat, potatoes, and cabbage into broth with various modes of cooking was studied. It was found that the amount of strontium-90 passing into broth from bones constituted but fractions of one percent, while in the instance of meat it was 50–60% and in that of potatoes and cabbage–20%. The duration of thermal treatment and the changes in the pH level had no effect on passage of radioactivity from products to solution. The addition of calcium and magnesium salts tended to increase strontium-90 passage into the broth. Seven times more strontium-90 was removed from peeled potato than from potato cooked in the jacket. (P.C.H.)

20239 (NP-tr-1124) DETERMINATION OF THE EFFICIENCY OF A FILTER BY MEANS OF RADIOACTIVE IONS OF KNOWN DIMENSIONS. J. Pradel, F. Billard, et al. Translated by O. S. Whitston (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.), from the "International Symposium on Radioactive Pollution of Gaseous Media, Saclay, France, November 12–16, 1963." 7p.

Aerosols were labeled with thorium-B (^{212}Pb) and their particle size distributions measured by sorption on two Zeleny tubes in series. Particle size distributions were determined for three standard aerosols, which were then used to test the efficiency of the Poelman Schneider pink filters. An increase of permeability with particle diameter was found in the range 1 to 100 mμ. (D.L.C.)

20240 THE RADIATION FIELD INSIDE SPACE VEHICLES. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). Aerospace Med., 35: 104-9 (Feb. 1964).

Problems to be expected in shielding the crew compartment and monitoring the radiation dose in a space vehicle are discussed. Shielding can be accomplished in large part by making use of the inherent attenuating power of construction material and equipment. However, use of this principle is limited because it will not be possible, for example, to distribute the weight completely uniformly around the compartment to be shielded. Also, in addition to ordinary cosmic radiation, the various high intensity radiation beams in space contain large fractions of particles of comparatively low penetrating power. The local radiation intensity within a vehicle, therefore, will depend in a complex fashion on both the geometrical shield configuration and the physical characteristics of the radiation. For three typical space radiation proton spectra, the distribution of air dose is analyzed computationally for a spherical shell of uniform wall thickness and for a conical vehicle carrying a heavy heat shield at the base. The results indicate that, even for the completely symmetrical spherical vessel, the air dose varies considerably at different radial locations due to the influence of shield geometry. For the ordinary cosmic ray beam, the local air dose is higher in regions where the effective shielding is heavier, contrary to flare produced and Van Allen Belt protons which show no buildup phenomenon. For the conical vehicle, the computational analysis is extended to the dosage distribution within a spherical tissue phantom of 30-cm diameter assumed in two locations, in the nose tip and close to the heat shield. The results show that the depth dose distribution in the phantom differs greatly with regard to absolute level as well as to radial symmetry at the two locations, and that

greatly different tissue doses in the phantom can be found at locations at which the same air dose is measured. It is concluded that accurate determination of the radiation exposure of the astronaut requires radiation monitors to be worn on the body; moreover, personal monitoring would be needed before the astronaut leaves the vehicle. Additional stationary sensors in the vehicle would be useful for larger vehicles. They would enable the astronaut at the controls to minimize exposure by correcting the attitude of the vehicle in relation to the incident beam, especially near the earth where the incident radiation is always strongly directional, and quick corrective action could substantially reduce the exposure. (BBB)

20241 PREVENTION OF, AND TREATMENT OF RADIATION-INDUCED CANCER, INCLUDING PURE ATOMIC AND CATHODE RAY LESIONS. James Barrett Brown (Washington Univ., St. Louis and Barnes Hospital, St. Louis). Ann. N. Y. Acad. Sci., 114: 849-50(Apr. 2, 1964).

Hazards from medical and industrial radiation exposures are reviewed briefly. The importance of the prevention of radiation injuries is stressed. (C.H.)

20242 THE SEALED SOURCE REGULATIONS AND DRAFT UNSEALED SOURCE REGULATIONS. I. K. Legge (Ministry of Labor, London). Ann. Occupational Hyg., 7: 9-12(Jan. 1964).

The Ionizing Radiations (Sealed Sources) Regulations 1961 apply only in premises subject to the Factories Act 1961. They require appropriate safety precautions in the use of sealed radioactive sources and machines that produce x-rays. The most important processes concerned are radiography, fluoroscopy, crystallography, thickness gauging, package monitoring, level gauging, and static elimination. Where reasonably practicable all sources of ionizing radiations should be adequately shielded. Work should be conducted so that workers receive the minimum amount of radiation and do not exceed the maximum permissible doses specified in the schedule. Workers employed in work involving the use of ionizing radiations and who work where the dose rate exceeds 0.75 mr/hr are classified workers, must wear a film badge, and have appropriate medical examinations. Further requirements include the provision of monitors, leakage testing of sealed sources, appointment of competent personnel and the keeping of appropriate records. Regulations dealing with unsealed radioactive substances are in draft form. (auth)

20243 THE APPLICATION OF SEALED SOURCE REGULATIONS. H. G. Thurston (Stewarts and Lloyds Ltd., Corby, Eng.). Ann. Occupational Hyg., 7: 13-21 (Jan. 1964).

The health physics measures used by industry to comply with the International Commission for Radiation Protection recommendations and the Ionizing Radiation Regulations are described, including the medical examination requirements and training program. Means of measuring dose are illustrated. Mention is made of containers used, methods of storage, handling, and identification of isotopes. Fire protection methods are detailed, and a description of the local safety measures adopted before the introduction of the Regulations is included. All health physics problems are discussed with reference to individual situations arising in a foundry using sealed sources of radiation. Illustrations of the type of equipment used under such approved schemes of work are shown, e.g. the use of isotopes for thickness gaging, checking the level of molten glass in a furnace, and checking the correct filling of packages. The use of shielding with industrial sources is considered; in most site applications the only protective barrier possible is that of distance. Where it is possible, and the work is repetitive, the radiographic work may be carried out in fixed enclosures and the pieces to be examined are brought to the enclosure. A typical example of this type of enclosure is illustrated. A method of handling radioisotopes is described which helps workers identify the source with the insert rod into which it is initially fitted and kept during its service life. (BBB)

20244 THE HOSPITALS CODE OF PRACTICE. J. E. Roberts (The Middlesex Hospital, London). Ann. Occupational Hyg., 7: 29-33(Jan. 1964).

Some of the problems involved in preparing a Code of Practice for the use of ionizing radiations in medical work are discussed. (auth)

20245 THE APPLICATION OF A UNIVERSITY CODE OF PRACTICE. J. C. Collins (Univ. of Manchester, Eng.). Ann. Occupational Hyg., 7: 35-9(Jan. 1964).

The Universities' Code of Practice comprises a balanced set of recommended procedures and is admirably designed for the special circumstances of university radiation work. Its adoption by Universities' Governing Bodies has guaranteed a sound control of radiation hazards in the universities and, at the same time, has allowed that flexibility vital to the progress of research. (auth)

20246 THE RADIOACTIVE SUBSTANCES ACT 1960. N. D. Baines (Ministry of Housing and Local Government, London). Ann. Occupational Hyg., 7: 47-51(Jan. 1964).

The Radioactive Substances Act 1960 that came into effect on December 1, 1963 requires persons who keep and use radioactive material to be registered with the Ministry of Housing and Local Government, and to obtain authorization for the accumulation and/or disposal of radioactive waste. Exemption from registration or authorization is granted where the use or nature of the material does not call for the full application of the controls in the Act. Exemption is usually subject to various conditions. Methods of radioactive waste disposal are described briefly. (auth)

20247 THE NUCLEAR INSTALLATIONS ACT. A. E. S. Clifford (Rolls Royce Ltd., Littleover, Derby, Eng.). Ann. Occupational Hyg., 7: 53-7(Jan. 1964).

The Nuclear Installations (Licensing and Insurance) Act 1959 came into force on April 1, 1960 and deals with the licensing and insurance of sites for nuclear installations in England, Scotland, and Northern Ireland. Except for installations of the U.K.A.E.A. and Government Departments and those comprised in any means of transport, control over the construction and operation of nuclear installations is given to the Minister of Power in England and Wales, to the Secretary of State in Scotland and to the Minister of Commerce in Northern Ireland. Under the Act no person may construct or operate a nuclear reactor or certain other installations on any site without first obtaining a license. The appropriate Minister has the power to attach to a license any conditions which he thinks desirable in the interests of safety. Because of the great difficulty which a person injured by radioactivity would in many cases have in proving that his injuries were due to the installation, the licensee is made absolutely liable (whether or not he has been negligent) for any injury or damage to anyone on or off the site caused by radiation arising from the operation of his installation, including radiation injury or damage caused by waste products from the installation or arising out of the carriage of nuclear fuel which has been irradiated at his installation. Because of the magnitude of possible claims from injured persons the Act requires the licensee to provide insurance

cover or similar security for £5 million. Government Departments and the U.K.A.E.A. have to obtain licenses and are liable in the same way for injury or damage but they do not have to provide insurance cover. Where a major incident leads to claims exceeding £5 million in total the licensee is not liable to make any payment over that amount until Parliament has considered the matter and decided how the claims should be met. (auth)

20248 TRANSPORT REGULATIONS. R. Gibson (United Kingdom Atomic Energy Authority, London). Ann. Occupational Hyg., 7: 59-62(Jan. 1964).

Problems arising from movement of radioactive materials outside of atomic energy establishments are discussed in relation to containment, shielding, criticality control, and heat transfer measures. Common constituents in a set of transport regulations based on the I.A.E.A. model are identified. (H.M.G.)

20249 THE FUTURE OF NATIONAL AND INTERNATIONAL REGULATIONS COVERING THE USE OF IONIZING RADIATIONS. D. F. Sim (United Kingdom Atomic Energy Authority, London). Ann. Occupational Hyg., 7: 63-9(Jan. 1964).

Fields in which regulations covering the use of ionizing radiations are already in force in the U.K. and fields still unregulated, or only partly regulated, in which there is scope for future regulations, including the practice of medicine and allied professions; research laboratories; nuclear ships; international control of disposal of radioactive waste in the sea; agriculture—the role of Government Departments—the disadvantages of over-regulating an industry—the possibility of the relaxation of regulations as knowledge and experience increase are discussed. (auth)

20250 BASIC DATA AND PRINCIPLES FOR THE INSURANCE OF RADIOISOTOPE APPLICATIONS. B. F. Schmitt. Atomwirtschaft, 9: 108-13(Mar. 1964). (In German)

Berthold and Vaupel worked out a system by which insurance companies could calculate premiums from risk values. In this system individual radionuclides were compared with the degree of danger from ^{60}Co. From the experience gained with ^{60}Co in various spheres of work it was possible to provide an arbitrary reference value for the dangerousness of radionuclides. The activity of the nuclide, its casing, and its state of aggregation also entered into the calculation of the risk value. The original basic concepts were re-examined. Technical development necessitated in a few places an expansion of the basic data to take account of multi-curie radiation sources as well as the admission of solid noble gas compounds into the earlier classification. The danger equivalent values had to be re-calculated on the basis of more recent medical knowledge as published by the International Commission on Radiological Protection. These values were incorporated in tables, which deal in part with the field of fire insurance. Finally the calculation of premium surcharges from the tabular values is demonstrated by means of an example. (auth)

20251 MONITORING OF RADIOACTIVE CONTAMINATION IN THE PHOTOGRAPHIC INDUSTRY. B. Rajewsky (Max-Planck Instituts fur Biophysik, Frankfurt am Main). Atomwirtschaft, 9: 129-30(Mar. 1964). (In German)

After the discovery, in the German Federal Republic, of the existence of radioactive contamination in air, water, and soil, the photographic industry became alarmed about the possible damaging effects on film production. A monitoring section was set up in 1956 in the Max Planck Institute for Biophysics, which continuously investigated, according to an arranged plan, samples of material from photographic concerns. The monitoring program included the determination of the surface activity accumulating monthly on the ground, the determination of the activity present in the factory and the determination of the radioactivity of sweepings from the factory. In addition to monitoring the contamination in the factory itself, raw materials for various stages of production, e.g., cartons and film packing material, were also tested for radioactivity. One result, for example, was that certain cartons for the storage of film showed a strong contamination. An analysis of the individual components of the cardboard showed that straw was responsible for this activity. As a result cartons for this purpose were manufactured only from wood and waste paper. Other originally obscure contaminations were explained as a result of these investigations. The seven years experience of the monitoring section indicated that even after the Test Ban Treaty comes into force radioactive contamination will be encountered in the factories of the photographic industry for a certain time. (auth)

20252 THE ROLE OF THE PUBLIC HEALTH INSPECTOR IN DISASTER. S. H. Kryszek (Emergency Health Services, Halifax, N. S.). Can. J. Public Health, 54: 437-9 (Sept. 1963).

The duties of the public health inspector will require him to supervise and report on water supplies including radiological status; supervise sanitation and radiological safety of all supplies of milk and food; supervise the processing of food, and inspect and report on all public sewage disposal facilities in overcrowded areas. Garbage disposal, control of insect parasites, and the sanitary inspection of welfare centers and emergency health units will be other responsibilities. Training of public health inspectors for civil defense preparedness is discussed. (BBB)

20253 SAFETY IN INDUSTRIAL USE OF RADIOACTIVE SOURCES. J. W. Kuhn (E. I. du Pont de Nemours & Co., Inc., Orange, Tex.). Chem. Eng. Progr., 60: No. 4, 41-4(Apr. 1964).

A proposal is given to simplify the application of radioactive sources so their advantages can be obtained without compromising on safety. An example of favorable industrial safety experience in applying radioactive sources at Saluné River Works substantiates the premise that under optimum controls such sources need to be more hazardous than other common industrial products. Design parameters, radiation protection officer, radiation survey meters, and recording of radiation exposure are suggested as safety features. (P.C.H.)

20254 RADIATION EXPOSURE AND RADIATION PROTECTION IN USE OF RADIOACTIVE ISOTOPES IN MEDICINE. D. Emrich and W. Keiderling (Medizinische Universitätsklinik, Freiburg i. B.). Deut. Med. Wochschr., 88: 515-19(Mar. 15, 1963). (In German)

In principle the biological effects of x radiation and energetic radiation from radionuclides are the same. In practical usage there are some differences. In order to afford protection from radionuclides used two types of dosimetry must be considered. These are personal and source dosimetry. Film badges and pocket dosimeters are adequate for personal protection. Portable or automatic radiation monitors are used for source dosimetry. Distance is an important factor to reduce exposure from a radiation source. Extreme cleanliness is a requisite for handling of radioisotopes once they are removed from the original container. In order to minimize the radiation exposure of patients there are several possibilities. One is

to use a radioisotope of the same chemical type, but with a shorter physical half life. An example of this is the substitution of ^{132}I, with a half life of 2.4 hr, for ^{131}I, with its half life of 8 days. Sometimes the biological half life of the isotope can be reduced by increasing its rate of elimination (decontamination), but this type of procedure is often not applicable to patients in clinical practice. If instruments with increased measurement sensitivity are used, smaller tracer doses can sometimes be used. Whole-body counters are especially useful here. Examples of tests where radiation exposure is reduced in this way are triolein excretion or absorption tests. Uptake of the radioisotope by a critical organ can be prevented if it is not required for carrying out the test. For instance, when ^{131}I-labeled compounds are used for tests of extrathyroidal function, such as radioiodinated albumin, triolein, rose bengal, or hippuran, it is feasible to block the thyroid to prevent uptake of any I that might be released from the compounds. Absolute contraindications against use of radioisotopes are pregnancy and sedation, or treatment of children, except in case of malignant growths. Also, in general, therapy with radioisotopes should not be administered to adults under 40 yr of age. (BBB)

20255 WHAT YOU SHOULD KNOW ABOUT FDA'S RADIOACTIVITY PROGRAM. E. P. Laug (Food and Drug Administration, Washington, D. C.). Food Eng., 35: 42-5 (July 1963).

The FDA program for protecting the consumer from radioactivity in food is described. Basic facts about fallout, effects of processing, surveillance procedures, and Federal Radiation Council guidelines are discussed. (P.C.H.)

20256 CANCER MORTALITY PATTERNS AMONG U.S. URANIUM MINERS AND MILLERS, 1950 THROUGH 1962. Joseph K. Wagoner, Victor E. Archer, Benjamin E. Carroll, Duncan A. Holaday, and Pope A. Lawrence (National Cancer Inst., Bethesda, Md. and Bureau of State Services, Salt Lake City). J. Natl. Cancer Inst., 32: 787-801(Apr. 1964).

Cancer mortality patterns of a group of U.S. uranium miners and millers were studied, and their age-race-cause-specific mortality experience was compared with that of the general male population of the Colorado Plateau area. Among white U millers, total and cause-specific mortality did not differ significantly from that expected. Among white U miners, 218 deaths were observed as compared with 148.7 expected ($P < 0.01$). Categories in which death significantly exceeded that expected were: respiratory neoplasms among U miners with five or more yr underground experience (11 observed as compared with 1.1 expected); all other causes, in the same groups of miners—a reflection of pulmonary fibrosis and its complications; and accidents, particularly in mines, regardless of type of employment or duration of underground mining experience. A possible explanation was sought for the tenfold increase in respiratory cancer among long-term underground U miners. This excess was not attributable to age, smoking, nativity, heredity, urbanization, self-selection, diagnostic accuracy, and prior hard-rock mining or other ore constituents including silica dust. The evidence presently available implicates airborne radiation in the genesis of this increase in respiratory cancer among U.S. U miners. (auth)

20257 THE PLANNING OF THE DANGER INDICATING AND WARNING EQUIPMENT FOR THE NUCLEAR RESEARCH ESTABLISHMENT AT JULICH. V. Aschoff. NTZ-Nachrtech. Z., 16: 253-5(May 1963). (In German)

Safety equipment for the Jülich Nuclear Research Center is described. Telemetering equipment is listed and its uses discussed. (M.C.G.)

20258 RADIATION CASUALTIES—NEWER ASPECTS OF MASS CASUALTY CARE. Eugene L. Saenger and Max L. M. Boone (Univ. of Cincinnati). N. Y. State J. Med., 64: 309-41(Jan. 15, 1964).

The treatment of casualties of a thermonuclear attack is discussed. The concept of the equivalent residual dose (ERD) is explained, and an empirical semiquantitative relation is developed so that ERD can be expressed combining both acute and chronic exposure. The ERD is calculated from the equation: $De = a D_0 + b\dot{D}$, where De is equivalent residual dose, D_0 the dose within 4 days, $\dot{D}$ the dose rate (r/day), and a and b are constants. The application of medical care planning rules to problems of diagnosis and therapy are discussed. As an aid to clinical diagnosis, the symptoms and signs of radiation disease are outlined. (BBB)

20259 PROBLEMS OF RADIOLOGICAL PROTECTION IN FLAW DETECTION. J. Domanus and M. Wolski. Ochrona Pracy, 17: No. 2, 8-10(1962). (In Polish)

All industrial flaw detection laboratories are covered, with respect to their radiological protection, by the supervision of the Inst. of Electrotechnics. A discussion is given of the results of this action, especially the cases of exceeding the admissible doses. The analysis of endangerment by radiation of employees of flaw detection laboratories is given. (auth)

20260 WORK SAFETY CONDITIONS WITH CLOSED RADIATION SOURCES. R. Brosziewicz. Ochrona Pracy, 18: No. 11, 3-7(1963). (In Polish)

A discussion is presented of principles of radiological protection observed in the Radiation Chemistry Dept. of the Nuclear Research Inst., during operation of large sources of ionizing radiation. It has been revealed that a properly designed servicing system of these sources ensures full protection of personnel even with not fully protected sources. (auth)

20261 X-RADIATION IN DENTAL OFFICES IN JEFFERSON COUNTY, ALABAMA. [PART] III. L. R. Manson-Hing, A. H. Wuehrmann, and H. C. Jamison (Univ. of Alabama, Birmingham). Oral Surg. Oral Med. Oral Pathol., 17: 192-8(Feb. 1964).

A survey of techniques and safety practices covering 222 x-ray machines examined in 195 offices and clinics is reported. The subjects investigated were: roentgenographic techniques, operators' positions, and personnel exposure. Most of the dentists questioned (135, or 66%) used both periapical and bite-wing projections; 36 others used occlusal projections in addition to intraoral techniques; and 9 used extraoral projections in addition to intraoral and occlusal methods. The target-skin distance varied from 6 to 60 in.; however, 178 (87.5%) of the dentists usually used a target-skin distance of 8 in. The type of film used was also recorded. The speed of intraoral films varied from slow to extra-fast, and 109 of the 204 dentists stated that they had not changed film speed in the last 10 yr. Ninety-four had changed to faster film. Consideration of the type of intraoral survey used in the dental offices of 204 practitioners showed that 168 dentists routinely obtained complete roentgenographic surveys of their patients, the number of intraoral films per survey varying from 4 to 20. The factors considered when studying positions of personnel were: presence of shielding material, distance, and position in relation to the primary beam of x radiation. Most (82%) of the dentists had either obtained a radiologic safety sur-

vey, used some type of personnel monitoring, modified their machines, arranged for the operator and assistant to be shielded, or sought positions at least 6 ft away from the patient when the machine was operated. Measurements of the rates of intensity of radiation were also made in other dental office locations often occupied by people. These estimated annual exposures of operators and assistants indicate that none exceeded the maximum annual exposure (5 r) set by the radiation protection guide of the National Bureau of Standards. (BBB)

20262 ESTIMATE OF IRREGULARITY IN SPECIFIC ENERGY LOSS IN CALCULATIONS OF MEAN DOSES OF α PARTICLES. A. M. Kononenko (Central Research Inst. of Roentgen-Radiology, Leningrad). Radiobiologiya, 3: 915-19(1963). (In Russian)

Formulas were developed for estimating doses of α particles from incorporated radioactive substances, considering the irregular specific energy losses along the particle track. (R.V.J.)

20263 DIAGNOSTIC AND THERAPEUTIC CONSIDERATIONS OF X-RAY HAZARD AND PROTECTION IN INFANTS AND CHILDREN. K. Gefferth (University Childrens' Clinic, Budapest). Radiol. Diagn., 3: 561-8(1962). (In German)

It is possible that radiation injuries may result from pelvimetric x-ray examinations, but the evidence is not completely conclusive. The greatest radiation sensitivity occurs during the first 5 to 7 weeks of pregnancy, but the children of Hiroshima and Nagasaki that suffered the greatest radiation damage were subjected to the radiation from the atomic explosions during the first 7 to 15 weeks of pregnancy. Children who are injured by at least 175 r to the thymus are usually only 2 or 3 months older than those who are in utero, so that the difference may be due to differences in effects of total or fractionated exposure to radiation. Generally, older children are less sensitive to radiation than younger children, and their larger size permits more precise localization of the x radiation and may prevent exposure of as large a proportion of their bodies. Lung exposures at the clinic are made at 40 to 50 kv with 3 to 3.5 ma, and most studies are completed in 30 sec. In infants the gonad dose is ~3.2 mr, and in children, ~2.2 mr. For lung photography in infants at 50 kv at a distance of 1 m with a long tube, and the gonads shielded, the gonadal dose is 1.3 mr. Visualization of an organ should not take longer than 30 sec, with the iris opening as small as possible. Filtration should be at least 3 mm Al. When x-ray photographs are taken an image intensifier can reduce exposure tenfold. The decision to use x-ray treatment depends upon the nature of the disease to be treated. Malignant tumors are an absolute indication. It is optional for epilation in fungus infections, thymus hyperplasia with respiratory embarassment, bone cysts where surgery is inadvisable, postencephalitic conditions, or intractable bone pain during leukemia. Radiation should never be used for thymus enlargement without symptoms, asthmatic conditions, pertussis, or cosmetic defects. (BBB)

20264 GONADAL DOSAGES IN INVESTIGATIVE RADIOGRAPHY. Stanley M. Garn, Frederic N. Silverman, and Ann A. Davis (Fels Research Inst., Yellow Springs, Ohio). Science, 143: 1039-40(Mar. 6, 1964).

Using radiation-sparing and radiation-limiting techniques, gonadal (skin) dosages in the course of investigative radiography averaged under 0.3 mr for a set of radiographs, a value less than the irreducible background dosage for one day. (auth)

20265 RADIOACTIVITY IN THE ATMOSPHERIC EFFLUENTS OF POWER PLANTS THAT USE FOSSIL FUELS. Merril Eisenbud and Henry G. Petrow (New York Univ., New York). Science, 144: 288-9(Apr. 17, 1964).

Analysis of the fly ash produced by combustion of pulverized Appalachian coal showed that a 1000-megawatt coal-burning power plant will discharge into the atmosphere from about 28 millicuries to nearly 1 curie per year of radium-226 and radium-228. An oil-burning plant of similar size will discharge about 0.5 millicurie of radium per year. Comparison of the data with data on the release of fission products from nuclear-powered generating stations shows that when the physical and biological properties of the various radionuclides are taken into consideration, the conventional fossil-fueled plants discharge relatively greater quantities of radioactive materials into the atmosphere than nuclear-powered plants of comparable size. (auth)

20266 THE DECONTAMINATION OF RADIOACTIVE WATER WITH CHEMICAL PRECIPITATION. H. Keese. Thesis, Brunswick, Technische Hochschule, 1963. 66p. $2.00(Gmelin, AED-DISS. 63-306). (In German)

Various precipitation methods, which can be used for effective decontamination of large quantities of weakly contaminated water, are studied. Decontamination factors for ^{144}Ce, ^{91}Y, ^{89}Sr, ^{90}Sr, ^{137}Cs, and ^{60}Co were determined. In some cases the adsorption isotherms are given. Results indicate that adsorption is linear up to activities of 90 μC/l. (Gmelin Inst.)

20267 RADIOLOGICAL HEALTH AND SAFETY IN MINING AND MILLING OF NUCLEAR MATERIALS. VOL. II. Proceedings of the Symposium Held in Vienna, 26-31 August 1963. (International Atomic Energy Agency, Vienna). Proceedings Series. Jan. 1964. 573p. (STI/PUB/78(Vol.II)). $11.00; Sch 231.-; 66s.stg; F.fr.44.-; DM 38.50. (IAEA)

Thirty-four papers were presented. Separate abstracts were prepared for seven. The remainder appear in NSA as: 17: 14652, 14877, 32311, 39317, 40760, 40912, 40913, 40914, 41137, 41138, 41140, 41143, 41146, 41147, 41154, 41155, 41156, 41157, 41158, 41160, 41164, 41165, 41166, 41167, 41168, 41170, and 42427. (H.M.G.)

For abstracts of individual papers see: 19916, 19917, 20268, 20269, 20270, 20271, and 20272.

20268 MEASUREMENT OF RADON AND RADON-DAUGHTER PRODUCTS IN MINES. H. L. Kusnetz (Dept. of Health, Education and Welfare, Washington, D. C.). p.37-48 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

Continuing activity in the U and Th mining and milling industry has resulted in the exposure of large numbers of workers to the radioactive elements. Of these products, those most likely to enter the body by inhalation are radon (^{222}Rn) and its daughters, and thoron (^{220}Rn) and its daughters. Accurate measurement of these products is necessary for determining the extent of the workers' exposures. Implementation of control methods, particularly by ventilation, and the evaluation of the efficacy of these controls is dependent on the ability to measure concentrations of radon, thoron and their daughters. Measurements are complicated by the fact that the contaminants may exist as the parent gas, as the unattached daughter atoms, or as daughter-bearing dust particles in the mine atmosphere. Further, measurement of concentrations underground is difficult because of the probability of instrument contamination.

Instrumentation must be rugged enough to withstand field usage, and must be simple enough to be handled and maintained at locations remote from the laboratory. The relatively short half lives of certain of the isotopes preclude any time-consuming sampling and analyzing procedures. Deviations from equilibrium between the parent gas and its respective daughters lead to complexities in interpretation of the measured data. The unavailability of uncontaminated air in the mine increases the problem of measurement and control. Recommended techniques are reviewed for field measurements of these contaminants. For radon, the scintillation effect in a phosphor may be utilized. Thoron may be measured directly by drawing the air stream through an ionization chamber. Concentrations of both of these gases may be estimated by measuring their respective daughter product concentrations. A technique for distinguishing ^{220}Rn daughters from the ^{222}Rn daughters is described. A theoretical description for estimating ventilation requirements in mines based on these measurements of daughter concentrations is presented. (auth)

20269 URANIUM-MINE VENTILATION FOR CONTROL OF RADON AND ITS DAUGHTER PRODUCTS. R. L. Harris, Jr., and R. E. Bales (Public Health Service Occupational Health Field Station, Salt Lake City). p.49-60 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

A problem common to all underground U mines is the inhalation exposure of workmen to Rn gas (^{222}Rn) and its radioactive decay products. Radiation dosage to pulmonary tissue from breathing air containing Rn is principally from the α-emitting decay or daughter products of Rn. For this reason the atmospheric concentration of Rn-daughter products, reported as Mev of potential alpha energy for decay to ^{210}Pb, is the parameter ordinarily used in the U. S. to assess these inhalation exposures. The most common device for the control of exposure is ventilation of working places with air which is free of, or low in, radioactive contamination. Knowledge of the steady-state concentration of Rn and its daughters in a working place, the volume of the place, and the quantity of uncontaminated air being supplied to it, permits calculation of the quantity of clean air theoretically necessary to reduce the concentration of Rn-daughter products to any other desired concentration. The controlling factor in such a situation is the rate at which Rn emanates into the workplace. Rigid mathematical definition of ventilation requirements involves a variety of measurements and lengthy calculation: the procedures are briefly reviewed. With certain simplifying assumptions a single exponential equation may be used to estimate ventilation requirements for attaining the desired concentration of Rn daughters in a workplace from single measurements of ventilation rate and steady-state daughter concentration in the place. The development of such an equation and a discussion of limitations in its application are presented. Experience in the application of calculations in practical situations is reported and certain variables which contribute to differences between predicted and actual values are discussed briefly. Ventilation for the control of thoron daughters is briefly explored. The relatively long half life of the intermediate daughter, thorium B (^{212}Pb), makes modest ventilation rates extremely effective in reducing the potential alpha energy of thoron daughters in a workplace. (auth)

20270 DUST PREVENTION IN NUCLEAR MATERIALS MINES. J. A. Northcott. p.83-97 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The need which arose in the metalliferous mining industry for the control of airborne dust is recalled. Present day standards and techniques for the prevention and suppression of dust were developed to a high degree in mines where this problem is fully recognized. In nuclear materials mining, questions involving airborne dust take on an added importance since a part of the radiation hazard is a function of the airborne dust concentration, and this is superimposed on the silicosis danger which results from the high silica content of many of the known U-bearing or other radioactive minerals. There is thus a double aim to be fulfilled by ensuring an adequate control of dust in mines, and the proper application of existing underground dust suppression practices would lead to a considerable reduction in the health risks to personnel working in mines of the type under discussion. Reference is made to the problems of underground dust prevention and also to the particular dust problems of small workings of the type which commonly exploit U-bearing deposits. The need for simple dust-control measures is particularly urgent in mines of this type. A number of methods and techniques for the practical control of dust are mentioned, and stress is laid on the necessity for the training of mine workers in the recognition of the dust hazard and the necessity of taking suitable precautions. A review of the activities of the International Labour Organization in the field of dust prevention in mines is included. (auth)

20271 URANIUM IN THE URINE OF MINERS EXPOSED TO URANIUM COMPOUNDS. D. Karajovic, M. Kilibarda, D. Panov, D. Djuric, M. Medjedovic, P. Raicevic, and V. Delic (Inst. of Occupational Medicine, Belgrade). p.443-50 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." Vienna, International Atomic Energy Agency, 1964.

The Department of Radiation Protection in the Institute of Occupational Health in Belgrade performs medical control tests of miners working in a Yugoslav U mine. During 1962 U in the urine of 213 miners was also determined. In 35% of the urine samples no U was found and in 65% of the urine samples U values varied to about 100 μg/l. The health condition of miners was checked with special attention paid to kidney damage. The greatest percentage of controlled miners (73%) had an employment duration of about 5 yr. The urine of all miners was checked for albuminuria, hematuria and cilinduria, urea in the blood, blood tension, and other clinical observations. None of these analyses revealed any damage to the kidneys, without considering the exposure duration or excretion of U in the urine. (auth)

20272 THE UNITED STATES ATOMIC ENERGY COMMISSION'S REGULATORY CONTROL PROGRAMME FOR URANIUM MILLING. D. A. Nussbaumer and D. F. Harmon (Atomic Energy Commission, Washington, D. C.). p.519-33 of "Radiological Health and Safety in Mining and Milling of Nuclear Materials. Vol. II." International Atomic Energy Agency, 1964.

The Atomic Energy Commission was vested by the Atomic Energy Act of 1954, as amended, with the authority and responsibility for regulatory control of radiological health and safety in the U. S. uranium milling industry. The Commission has promulgated regulations, established standards, developed guides and criteria, and instituted a licensing and inspection program to discharge this responsibility. A brief history of the milling industry is presented with particular emphasis on the development of the Commission's regulatory control program. Information on the

Commission's present licensing program is described and discussed. Topics covered include: applicable regulations; licensing guides; requirements for the issuance of licences including a summary of the information which applicants must submit in support of applications for licences; considerations in technical evaluation of applications; the Commission's inspection and enforcement program; limits for external radiation exposures and concentrations of airborne uranium and its daughter products in air and water; and procedures and bases for granting certain exemptions and special authorizations pursuant to applicable regulations. An identification and discussion of those phases of milling operations that require consideration from a radiation safety standpoint are included. Among the items discussed are control of airborne radioactivity resulting from dust-producing operations such as crushing and grinding, sample preparation and final product packaging; criteria for use of respirators in controlling exposure of workers to airborne radioactivity; treatment and control of liquid effluents; retention of liquid and solid tailings; criteria for construction and maintenance of earth dam retention systems; and requirements for shut-down and abandonment of uranium mills. (auth)

20273 RADIOLOGICAL EMERGENCY PROCEDURES FOR THE NON-SPECIALIST. Karl F. Oerlein (Defense Atomic Support Agency, Washington, D. C.). Nov. 1963. 42p. $0.35(GPO)

The hazards of nuclear radiation are compared to other hazards of modern daily living. The most essential steps to take in case of an accident involving radioactive materials are outlined for the information and guidance of the layman who may find himself involved in such an accident. (C.H.)

20274 STRAHLENSCHUTZPRAXIS. TEIL I. GRUNDLAGEN. (Radiation Protection Practice. Part I. Fundamentals). Wolfgang Jacobi. Munich, Verlag Karl Thiemig KG, 1962. 110p.

Principles of radiation protection are discussed. Topics covered include: ionizing radiations and their origin, primary processes of the interactions of ionizing radiation with tissue, dose concepts and dose units, dose calculations for man from external radiation, incorporation of radioactive materials in the body, biological radiation effects and radiation injuries, effects of radiation from natural sources on man, the highest permissible radiation burden for man, and the present radiation burden of man. (M.C.G.)

20275 STRAHLENSCHUTZPRAXIS. TEIL II. MESSTECHNIK. (Radiation Protection Practice. Part II. Measurement Techniques). Martin Oberhofer. Munich, Verlag Karl Thiemig KG, 1962. 293p.

Methods of radiation measurement for use in radiation protection are discussed. Topics covered include: basic principles of radiation detection, design and manner of operation of radiation detectors, radiation protection measuring instruments, standardization and calibration of dose and dose-rate measuring instruments, contamination measurements, and testing of tightness of sealed radioactive preparations. (M.C.G.)

INSTRUMENTATION

General

Refer also to abstracts 19994, 19995, 20539, and 21481.

20276 (AAEC/TM-227) TWO MODES OF PULSE RECORDING ON MAGNETIC TAPE. R. A. Fookes (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1963. 16p.

Methods and equipment are described whereby electrical pulses are recorded on magnetic tape in two different ways, using a commercial, single-track type deck. The first method is used to record count rate information regarding regularly or randomly occurring pulses. Random count rates up to approximately 2,000 per second can be directly recorded without serious dead-time loss. By the addition of a simple, high-resolution scale-of-4, the input count rate can be increased to approximately 20,000 per second. By the other method information about relative pulse amplitude as well as count rate is recorded. The usable amplitude analogue output corresponds to an input range of at least 7 to 1, with linearity of approximately 1½ per cent of maximum amplitude. Amplitude resolution of 2 to 3 per cent is obtained over the upper 70 per cent of the range. Transistorized circuitry is described which enables the output pulses of the tape recorder to be analysed by a Radiation Counter Laboratories Inc. 256 channel scaler-analyser. (auth)

20277 (ADR-09-06b-62) BETA RADIATION METHOD OF THICKNESS MEASUREMENT. Dennis Becker (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). Dec. 1, 1962. 21p.

At the present time there are available numerous methods of non-destructive thickness measurement. To date, however, there is still a need to develop a method which has the following capabilities: 1. To accurately measure the thickness of a coating upon a base, regardless of the nature of the materials constituting the binary system. 2. To accomplish this withoug requiring related reference thickness standards. The application of beta absorption to the measurement of a coating thickness upon a base material was subsequently investigated. Specimens of copper-coated fiberglass were used. There developed from this study a method of non-destructive thickness measurement which has the above capabilities. (auth)

20278 (AEEW-R-329) A NOTE ON ERRORS AND SIGNAL TO NOISE RATIO OF BINARY CROSS-CORRELATION MEASUREMENTS OF SYSTEM IMPULSE RESPONSE. J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Feb. 1964. 38p.

The sources of error in the measurement of system impulse response using test signals of a discrete interval binary nature are considered. Methods of correcting for the errors due to theoretical imperfections are given, and the variance of the estimate of the system impulse response due to random noise is determined. Several topics related to the main topic are also examined. (auth)

20279 (BNL-7867) THE FIELD-EFFECT TRANSISTOR— ITS CHARACTERISTICS AND APPLICATIONS. V. Radeka (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 13p. (CONF-182-6).

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

The characteristics of the field-effect transistor with junction gate and the basic relations among its parameters are summarized to indicate its most important features for use in nuclear instrumentation. Some figures of merit are derived in terms of its physical parameters, and the limitations are considered. Some applications in nuclear instrumentation are discussed. (auth)

20280 (CERN-64-21) A DISTRIBUTED MULTI-CHANNEL COMMUNICATIONS SYSTEM FOR FLEXIBLE REMOTE CONTROL AND TELEMETRY. B. Sagnell (European Organization for Nuclear Research, Geneva). Apr. 17, 1964. 81p.

A faster and more efficient way of installing remote controls and indications than by direct wiring is presented. The new system employs well-known carrier signalling techniques and a common trunk cable, and can link equipment inside a large area with both ON/OFF and analogue signals. The system is explained in a block diagram. Typical equipment and applications are shown and all relevant characteristics are listed. (auth)

20281 (EUR-523.f) DISPOSITIF DE MESURES DE LA PURETE NUCLEAIRE DES MATERIAUX PAR LA METHODE D'OSCILLATION. (Device for the Determination of the Purity of Reactor-Grade Materials by the Oscillation Method). A. Anzani, I. Bredael, and F. Sciuto (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 35p.

A description is given of a test equipment for the measurement of the nuclear purity of materials by the oscillation method with the nuclear reactor AGN-201 "Costanza." The interest of this realization resides in its high precision and flexibility. These results have been obtained by pulse techniques. (auth)

20282 (HW-SA-3035) THE MEASUREMENT OF METAL TEMPERATURE BY AN ELECTROMAGNETIC INDUCTION METHOD (thesis). Hugo Leander Libby (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 3, 1963. Contract AT(45-1)-1350. 49p.

The principles of the measurement of metal temperature by an electromagnetic induction method, called inductive thermometry, are recounted and related to the highly developed electromagnetic nondestructive testing techniques. Although subject to many test variables, the method shows promise of fulfilling a need where fast response is required or where physical contact with the test metal is undesirable or impractical. Measured values of the impedance of practical solenoids having in their electromagnetic fields common electrically conducting materials are shown and compared with calculated values of the impedance per unit length of an infinitely long solenoid with conducting core. An application of the method in a heat transfer test of a nuclear fuel element is described. The presence of ¼, ⅜, and ½ inch diameter fabricated nonbonds between the fuel element jacket and core were detected employing a scanning technique, heating the surface with a plasma arc jet, and monitoring the surface temperature using the inductive thermometry method. (auth)

20283 (NAA-SR-Memo-8073) PLATINUM RESISTANCE THERMOMETER CIRCUIT WITH 5 VOLTS OUTPUT. David Terris (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 15, 1963. Contract AT(11-1)-Gen-8. 10p.

The analysis shows that there is a conflict between achieving a low value of thermometer resistance, which is needed to achieve small size and weight, and keeping a narrow temperature span between bridge balance temperature and maximum output temperature. Allowing 20 Mw to be dissipated in the detector, it is found that even with a temperature span as wide as 32°F to 1300°F, the detector resistance must still be 850 Ω at 32°F. This is a good five times greater than desired. To achieve a 5 volt output at maximum temperature, the alternatives are to either accept a large and heavy detector and a wide temperature span or find a way to allow greater dissipation in the detector without self-heating, thereby achieving both a smaller detector resistance and a more narrow temperature span. (auth)

20284 (NAA-SR-Memo-8435) QUICK-RECOVERY GATE GENERATOR. L. S. Beller (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 26, 1963. Contract AT(11-1)-Gen-8. 10p.

A triggered pulse generator, which provides complementary output pulses variable in width from two to ten microseconds and in height from zero to ten volts, is described. Special attention is paid to recovery time; succeeding pulses can be obtained less than a quarter microsecond following any pulse. (auth)

20285 (SCL-DR-64-13) 6-GC MICROWAVE DISCRIMINATORS. J. F. Barham (Sandia Corp. Livermore Lab., Livermore, Calif.). Apr. 1964. Contract AT(29-1)-789. 24p.

The design and operation of a series-tuned, microwave, f-m discriminator capable of demodulating fast-risetime telemetry information are described. Increased off-band rejection over previous discriminators allows this design to be used in multiple-channel systems without requiring separation filters. Improved packaging has resulted in easier adjustment of bandpass characteristics and higher reliability in ground-station environments. (auth)

20286 (UCRL-7327) STATIC AND DYNAMIC BEHAVIOR OF HELIUM GAS THERMOMETERS BELOW 77° KELVIN. David C. Holten (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 16, 1963. Contract W-7405-eng-48. 40p. (CONF-176-6)

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

The investigation of the static behavior of high-pressure gas thermometers includes considerations of phase equilibria and the development of analytical pressure-temperature relations. An accounting of corrective factors affecting the design and experimental accuracy of thermometer systems—namely cold volume shrinkage, capillary tube effects, and ambient temperature variations—is also given. Dynamic characteristics, as exemplified by system time response, are considered analytically from both the heat- and mass-transfer aspects. Experimental investigations are included which cover both types of behavior. The data obtained substantiate the predicted static response, and indicate that the dynamic response is strongly controlled by heat transfer in the cold sections of the thermometer. A method of improving this heat transfer is experimentally accomplished, which results in time responses of less than 500 milliseconds in the 6 to 12°K temperature range. (auth)

20287 (EURAEC-961(Pt.2)) A STUDY OF SOME PROBLEMS OF METAL OXIDATION AND APPLICATION OF IMPEDANCE MEASUREMENT METHODS TO THE STUDY OF RESISTANCE TO CORROSION IN AN AQUEOUS MEDIUM. Quarterly Report No. 7, October 1 to December 31, 1963. (Brussels. Universite). Work Performed under United States–Euratom Joint Research and Development Program. Contract 012-63-10 TEEB. 21p. (A translation).

The behavior of various oxidized electrodes is to be studied by: recording of the differential capacity in relation to the conditions, coulometric determination of the oxide film by the chronopotentiometric method, and measurement of the reactivity of the electrode in relation to various reactions of oxidation-reduction. The electrolytic cell and instruments for measuring differential capacities are described. (auth)

20288 ON MEASURING BY MEANS OF PROTON MAGNETOMETER IN HEL OBSERVATORY. Yu. Yankovskii and B. Yanke. Acta Geophys. Polon., 11: 199-202(1963). (In Russian)

The theoretical basis for the operation of the proton precession magnetometer, which makes use of the magnetic properties of the proton to measure the total intensity of the geomagnetic field, is discussed. (C.E.S.)

20289 HOT-WIRE CALORIMETER STUDY OF ION PRODUCTION AND ACCELERATION. V. A. Sandborn and L. V. Baldwin (Colorado State Univ., Fort Collins). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 660-6(Apr. 1964).

Detailed performance characteristics are presented for a porous tungsten ion source with an electrostatic Pierce accelerator system. This system is similar in principle to proposed space propulsion systems. Cesium ion production was accurately predicted from free molecular flow calibrations of the porous tungsten ionizer. Measured critical emitter temperatures exhibited a hysteresis that was explained by Taylor and Langmuir's data for cesium contact ionization on solid tungsten. Hot-wire calorimeter surveys of the beam were used to evaluate the performance of a cylindrical Pierce accelerator system employing a virtual or plasma-potential "decelerator." The loss of performance due to the exit electrode aperture was compared with theory for accelerator aspect ratios ranging from 0.6 to 1.3. The total beam power available from a given geometry (Child's law) was greatly increased by a countercurrent electron flow, which issued from a local electron emitter placed within the accelerator. This countercurrent electron configuration may offer a means of obtaining large improvements in engine efficiency. (auth)

20290 LINEAR PARALLEL TO SERIAL CONVERSION. P. Stuber (Princeton Univ., N. J.). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 10-15(Apr. 1964).

The system accepts up to 21 simultaneous pulses in parallel and forms a train of pulses for the display on a single channel scope. Representative pulses have the following characteristics: ~15 nsec wide at the base line, ~5 nsec rise time, ~1 ma peak current. Each channel contains a linear gate, controlled by the same event pulse. Upon arrival of the event pulse, the 21 channels open simultaneously for ~25 nec and allow transmission of the signal pulses into a system of 20 cable delay sections, connected in series. Each joint is a feedpoint for one signal pulse as passed by its corresponding linear gate. The 21 roughly simultaneously occurring pulses can now be displayed as a train of pulses on a single channel scope. Circuit design and performance data are given. (auth)

20291 BEHAVIOR OF TUNNEL DIODE AMPLITUDE DISCRIMINATORS. F. Pandarese (Brookhaven National Lab., Upton, N. Y.). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 16-23(Apr. 1964). (BNL-7575)

The dependence of the output of a tunnel diode amplitude discriminator on the excess over threshold is analyzed; the input pulse is assumed to be from a scintillation counter. An approximate formula for the maximum delay introduced is given. The results of numerical integration are summarized in a diagram, allowing the calculation of the delay introduced for various values of excess over threshold and of circuit time constants. (auth)

20292 A TRANSISTORIZED FAIL-SAFE HIGH-LOW TRIP. J. Kella and S. Rozen (Atomic Energy Commission, Tel-Aviv, Israel). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 24-7(Apr. 1964).

A transistorized trip circuit is described that was designed according to a-c fail-safe principles, the circuit trips being on high and low levels, thus indicating off normal input conditions. Both levels are detected by a single regenerative comparator. The output decays within 3 msec after a trip condition, independent of input signal slope or level. The circuit possesses an inherent static trip state lock. (auth)

20293 AN ELECTRON-SPIN-RESONANCE SPECTROMETER FOR USE WHILE IRRADIATING WET BIOLOGICAL SYSTEMS. R. F. Cook and L. G. Stoodley (Royal Military Coll. of Science, Swindon, Eng.). Intern. J. Radiation Biol., 7: 155-60(Aug. 1963).

By taking electron-spin-resonance spectra at 300 Mc/s, rather than at the usual 10,000 Mc/s, the dielectric effect of any water that may be contained in a sample is greatly reduced, and much wetter systems can be studied without the necessity of using very small samples. Useful sensitivities are available at this frequency, and the instrument described has a sensitivity of 5×10^{15} spins of crystalline DPPH. The spectrometer can also be used with a suitable x- or gamma-radiation source to enable spectra to be taken during irradiation. Some examples of the growth and decay of free radicals in irradiated wet seeds are given to show the possibilities of the instrument. (auth)

20294 RUBIDIUM SELF-OSCILLATING MAGNETOMETER FOR EARTH'S FIELD MEASUREMENTS. W. F. Stuart, M. J. Usher, and S. H. Hall (Imperial Coll. of Science and Tech., London). Nature, 201: 76(Apr. 4, 1964).

The magnetometer, using optically pumped rubidium vapor and measuring the field by counting the frequency of self-oscillation, is described. A helium magnetometer was also constructed. (M.J.T.)

20295 THE DESIGN AND CONSTRUCTION OF SIX DIGITISED MICROSCOPES FOR THE MEASUREMENT OF BUBBLE CHAMBER PHOTOGRAPHS. M. J. B. Duff and C. J. Robinson (University Coll., London). Nucl. Instr. Methods, 25: 197-204(Jan. 1964).

Digitized microscopes for the measurement of track chamber photographs have been designed and constructed. The measuring accuracy is about $\pm 2\frac{1}{2}$ microns over a 20 cm square measuring area. Two microscopes have now been in use for some months. (auth)

20296 DETECTION OF PULSE PILE-UPS WITH TUNNEL DIODES. J. D. McGervey and Virginia F. Walters (Western Reserve Univ., Cleveland). Nucl. Instr. Methods, 25: 219-20(Jan. 1964).

A pile-up rejector using tunnel diodes is described. It is simple and reliable, and is capable of 30 nsec resolving time on pulses from plastic scintillators. Some general features of pile-up rejector circuits are discussed. (auth)

20297 ABSOLUTE GAS PRESSURE MEASUREMENT AND REGULATION NEAR ONE TORR. T. H. Jeong and L. H. Johnston (Univ. of Minnesota, Minneapolis). Nucl. Instr. Methods, 25: 221-3(Jan. 1964).

A composite mechanical system of absolute pressure measurement and density regulation of a flowing gas target, used in high precision nuclear scattering experiments, is described. Absolute pressures of one torr are read accurately to 10^{-3} torr. The sensitivity could readily be extended to 10^{-5} torr. The regulator controls the exit rate of the gas in such a way that the gas density in the scattering chamber is maintained constant in spite of variations in temperature. (auth)

20298 COMPUTATION OF 6th ORDER COMPENSATED SOLENOIDS WITH A MINIMUM WINDING VOLUME. B. Girard and M. Sauzade (Institut d'Electronique, Orsay, France). Nucl. Instr. Methods, 25: 269-84(Jan. 1964). (In French)

The discovery that some materials will remain superconducting in strong magnetic fields while carrying very large currents created the possibilities of producing very strong magnetic fields with superconducting magnets. Superconducting solenoids seem to be especially suitable for building a high resolution nuclear resonance spectrometer provided that magnetic field homogeneity be sufficient. To attain this end we have computed sixth order solenoids with an electronic digital computer. We establish the theory of compensating winding dimensions for a large number of solenoids keeping to a minimum the winding volume in order to reduce the quantity of superconducting material. Results are published in curves and table form. (auth)

20299 REGULATED SUPPLY OF HIGH STABILITY CAPABLE OF GIVING 1 AMPERE UNDER 15 VOLTS. P. Vergezac (Collège de France, Paris). Nucl. Instr., Methods, 26: 29-30(Feb. 1964). (In French)

With a combination of a heaving prosthesis tube and transistors one can have a regulated supply capable of giving 1 ampere under 15 volts, with a maximum variation of 60 mv as a function of the charge and with a stability of 2×10^{-4} during 10 hr of operation. (auth)

20300 NANOSECOND PULSE GENERATOR AND CIRCUIT USING AVALANCHE TRANSISTORS. J. J. Samueli, A. Sarazin, and J. Guyon (Institut de Physique Nucléaire, Lyon). Nucl. Instr. Methods, 26: 71-6(Feb. 1964). (In French)

A pulse generator, which operates at high continuous repetition rates and produces rectangular or exponential pulses is described. The circuit is all solid-state and uses avalanche transistors. At 5 Mc the pulse width is adjustable from 2 to 10 nanoseconds with a 0.5-nanosecond rise time and 8-volt amplitude on 50 ohms. At 25 Mc exponential pulses are produced with 1-nanosecond rise and 15-nanosecond fall times. (auth)

20301 A BINARY-DECIMAL AND OCTAL-DECIMAL CONVERTER AND ADDING MACHINE. A. J. Oxley (Oxford Univ.). Nucl. Instr. Methods, 26: 77-82(Feb. 1964).

The machine accepts inputs in binary or octal form and converts them to their decimal equivalents, which are displayed on dekatrons. The input digits are normally set up by hand, though with slight modifications suitable electrical inputs can be accepted, and either straightforward conversion, or addition or subtraction from the currently displayed number is possible. The maximum capacity is $2^{23}-1$

(binary or octal) and 10^7-1 (decimal), and all conversions, etc., take about half a second after the input number is set up. A brief description is also given of a similar but simpler and slower version of the machine, using cold cathode tubes throughout. (auth)

20302 A TUNNEL DIODE SINGLE CHANNEL PULSE HEIGHT ANALYZER. U. Sold and S. Brojdo (Israel Atomic Energy Commission, Rehovoth). Nucl. Instr. Methods, 26: 147-51(Feb. 1964).

A single-channel pulse-height analyzer is described using tunnel diodes as discrimination and shaping elements. Results obtained with the instrument give a base line of 10 mv to 10 v and channel width of 0 to 100 mv. Drift due to temperature is 5 mv/10°C. Dead time is less than 1 μsec and minimum rise time of input pulse is 10 nanosec. (auth)

20303 IMPROVEMENT OF PERFORMANCE OF A SQUARE WAVE GENERATOR. G. Beuchot and A. Boyer (Institut National des Sciences Appliquees, Villeurbanne, France). Nucl. Instr. Methods, 26: 187-8(Feb. 1964). (In French)

A transistorized square-wave generator is considered that has, between collector and base, a coaxial delay cable. The performance of this generator is improved by the addition of a second cable, having the same impedance as the first, in an open-end fashion between collector and ground. The improved version has a total rise and fall time of 0.6 nsec and a repetition rate of 250 Mc. (T.F.H.)

20304 ELECTRONIC DESIGN FOR NUCLEAR SPACE VEHICLES. PART I. HOW RADIATION ENVIRONMENT AFFECTS ELECTRONIC DESIGN APPROACHES. D. J. Niehaus and F. Larin (Bendix Corp., Southfield, Mich.). Nucleonics, 22: No. 5, 85-6; 88-90(May 1964).

The probable radiation environments and consequent areas of sensitivity to radiation damage are described for several missions—SNAP, NERVA, LASV-N, RIFT booster, long life space vehicles, and RIFT. Displacement and surface effects are discussed. (M.J.T.)

20305 SECOND INTERNATIONAL SYMPOSIUM ON RESIDUAL GASES IN ELECTRON TUBES, MILAN, 12th-15th MARCH, 1963. Paolo Della Porta, ed. Nuovo Cimento (1), 1: Suppl. No. 2, 397-854(1963).

Various aspects of residual gases in different types of electron tubes are discussed. The omegatron mass spectrometer, ion pumps, getters, vacuum electron-bombardment methods, outgassing of metals, characteristics of cut-off tubes, photomultipliers, and cold-cathode tubes are discussed. 40 papers were presented. (R.E.U.)

20306 TWO-STAGE MAGNETIC MASS SPECTROMETER. N. I. Ionov and V. I. Karataev (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 138-41(Jan.-Feb. 1964). (In Russian)

A magnetic mass spectrometer composed of two stages combined in one vacuum chamber with 180° focusing in each stage is described. Expressions for the linear and specific dispersion of the spectrometer are given. As an example the mass spectra of the isotopes in natural potassium are used to show the possibility of quantitatively measuring two peaks that differ by one mass unit for an intensity ratio of 10^6 to 10^7. (tr-auth)

20307 DEVICE FOR OBSERVATION OF THE EFFECTS OF LIGHT AND FIELD ON SEMICONDUCTORS. E. E. Zablovskii and Ya. A. Oksman (State Inst. for Optics, USSR). Pribory i Tekhn. Eksperim., No. 1, 180-2(Jan.-Feb. 1964). (In Russian)

A device for performing stationary and kinetic measurements of the increase of the component of complex conductivity of polycrystalline phosphors caused by light, fields, or their combined effects is described. The instrument can also be used for investigating the properties of high-resistance semiconductors and p-n junctions. (tr-auth)

20308 FLASH ROENTGEN TUBES: A NEW SYSTEM FOR GENERATION OF ROENTGEN RAYS—A SURVEY. Tord Olin and Carl Carlsson (University Hospital, Lund, Sweden). Radiologe, 2: 451-5(Dec. 1962).

The construction, specifications, and application of x-ray tubes based on the field emission principle are discussed. It is pointed out that the electron current density in a diode is a function of the temperature of the cathode and of the electric field applied. If the applied electric field is smaller than 10^6 v/cm as in a conventional Coolidge tube, the current density will not exceed ~10 a/cm^2, but if the field is increased to ~ a million v/cm and the cathode is 2700 to 3000°K, not only thermal emission but also field emission of electrons will occur; such mixed emission is called T-F emission (T = temperature, F = field). If the electric field is very strong, 10^7 to 10^8 v/cm, the field emission will be predominant. Within the T-F interval the current density will be about 1000 a/cm^2 at temperatures of 2700 to 3000°K at the tungsten cathode. One commercially available roentgen tube working within the T-F interval is called the Fexitron flash roentgen tube. The extremely high current density produced by T-F emission can be utilized either for extreme minimization of the size of the tube or for achieving enormously high currents through the tube which then enables reduction of the exposure times. Fexitron tubes were designed mainly for ballistic studies; reduction of the exposure times allows recording well-defined images of the sequence of events during explosions. Because of the short exposure times it is possible to hold the tube in the hand during exposure of the film without any consequent loss of sharpness of the image. Fexitron tubes have only found little use in diagnostic radiology, but in situations where the sharpness of the image is impaired by movements of the object to be studied they should prove useful. Thus, movements of parts of the body which are very rapid, e.g., heart valves and vocal cords, could probably be studied in detail with a flash x-ray tube. Calcifications in the heart, in coronary vessels and in valves, which are often difficult to distinguish in conventional roentgenograms owing to the rapid movement of these parts, could be visualized with this device. A very small tube has been constructed for use within the body, and the whole apparatus can be made portable, compact, and battery-powered. It is suggested that the radiobiologic effect of rapid pulses from the flash light tube probably differs somewhat from conventionally administered x irradiation. (BBB)

20309 AN ISOCHRONAL DIFFERENTIAL MICROCALORIMETER. R. A. Arndt and F. E. Fujita (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 34: 868-72(Aug. 1963). (BNL-6676)

An isochronal differential-type microcalorimeter has been designed and constructed. As a result of its simple design it is very easy to handle the samples and assemble the calorimeter. Important to the operation of the calorimeter is a program, also working on the differential principle, that provides linear temperature rise of the samples. The calorimeter is used to measure very small energy releases such as those found in precipitation, stored energy, etc. It is demonstrated that the calorimeter is easily capable of measuring 0.005 cal with a probable error of the order of 1 to 2%. (auth)

20310 THEORY OF STATIONARY RADIATION OF A HOMOGENEOUS SYSTEM IN A MULTIMODE RESONATOR. I. DEPENDENCE OF RADIATION ON THE SWING. G. Yu. Buryakovskii and V. S. Mashkevich (Inst. of Physics, Kiev). Ukr. Fiz. Zh., 9: 14-25(Jan. 1964). (In Ukrainian)

On the basis of the kinetic equations method, the theory of stationary radiation of a homogeneous system in a resonator was developed in the case when there is a great number of resonator modes within the width of the radiation line. For regions of weak and strong swings an explicit dependence on the swing is obtained for the radiation of resonator modes. It is shown that if the number of modes at which considerable generation of induced radiation occurs is small in comparison with the full number of modes, there exists a pronounced threshold value of the swing. The width of the threshold region is found. (auth)

20311 A MASS SPECTROGRAPH FOR ANALYSIS OF FISSION-PRODUCT BEAMS. Heinz Ewald, Ewald Konecny, Hans Opower, and Helmut Roesler (Technische Hochschule, Munich). Z. Naturforsch., 19a: 194-200(Feb. 1964). (In German)

A double-focusing mass spectrograph was built for direct analysis of fission products, which, with their high kinetic initial energy (50 to 110 Mev) and high ion charge number (about 18 to 25), come from a thin ^{235}U layer. These layers are in an evacuated radiation tube in the high neutron flux in the vicinity of the core of the research reactor in Garching. The spectrograph is attached at the external end of this radiation tube and forms with it a common vacuum system. The total beam path has a length of about 17 m. It was used for resolution of about 150 well-separated M/e spectra of high-energy particles. (tr-auth)

20312 MASS SPECTROGRAPHIC SEPARATION OF ENERGY-RICH ION BEAMS FROM FISSION OF ^{235}U WITH THERMAL NEUTRONS. Ewald Konecny, Hans Opower, and Heinz Ewald (Technische Hochschule, Munich). Z. Naturforsch., 19a: 200-9(Feb. 1964). (In German)

With the mass spectrograph previously described, fission products, which originate with high ion charge number e from a thin ^{235}U layer, can be separated according to their effective mass number M/e. One of the spectra obtained in this way for a heavy fission particle group was analyzed with regard to ion charge number, mass number, and intensity of its lines. It was compared with spectra whose M/e values and intensities were calculated with regard to the selection characteristics of the spectrograph from known data on the frequency distribution of the ion charge numbers, mass numbers, and energies of the fission products. The fine structure of the fission yield curve in the neighborhood of the mass number 134 was investigated. From this it was shown that for asymmetric fission, on the basis of the energy distribution of the fission products and on account of the selection characteristics of the spectrograph for suitable choice of deflection field, lines for each frequently occurring mass number of the heavy group could be separated from one another and could be obtained fairly free from overlapping by other lines. (tr-auth)

20313 DIFFRACTION OF OPEN RESONATORS AND WAVE GUIDES WITH PLANE MIRRORS. L. A. Vainshtein (Moscow Inst. of Problems in Physics). Zh. Tekhn. Fiz., 34: 193-204(Feb. 1964). (In Russian)

The theory of natural oscillations in open resonators formed by parallel plane mirrors (rectangular or spherical) is discussed. Simple expressions were obtained for currents on mirrors, for the field between mirrors, and for complex intrinsic frequencies. It is shown that waves in open waveguides formed by periodically distributed parallel mirrors are subject to the same regularities as oscillations in open resonators. The obtained results are generalized for the case of arbitrarily shaped mirrors (convex, etc). (tr-auth)

20314 OPEN RESONATORS WITH CYLINDRICAL MIRRORS. L. A. Vainshtein (Moscow Inst. of Problems in Physics). Zh. Tekhn. Fiz., 34: 205-17(Feb. 1964). (In Russian)

Investigations were made of two-dimensional natural oscillations in open resonators with two infinitely long cylindrical mirrors and of three-dimensional oscillations in open resonators with two finite-length cylindrical mirrors. It is shown that the reduced radiation losses in convex-mirror open resonators are caused by surfaces in which natural oscillations appear as attenuating waves. Natural frequencies and field and current distributions were calculated. (tr-auth)

20315 ON ATTENUATION IN A SPIRAL WAVE GUIDE. M. Z. Vishnevetskii, B. V. Kondrat'ev, and V. N. Solov'eva (Khar'kov State Univ.). Zh. Tekhn. Fiz., 34: 374-6(Feb. 1964). (In Russian)

Dispersion equations were developed for β attenuation as a function of the container and of the width of the spiral band 2l. (R.V.J.)

20316 QUANTUM ELECTRONICS, PROCEEDINGS OF THE THIRD INTERNATIONAL CONGRESS. VOLUMES I AND II. Pierre Grivet and Nicholaas Bloembergen, eds. New York, Columbia University Press, 1964. 1923p. $35.00.

A collection of 200 papers and discussions on applications and theoretical considerations of the laser and maser, presented at the Third International Conference on Quantum Electronics at Paris, February 11 to 15, 1963, is presented. The theory of coherence and noise, optical pumping and magnetometers, molecular beam masers, gas lasers, spectroscopy of solid state maser materials, solid state masers, solid state lasers, laser modes and special techniques, nonlinear optics, and semiconductor and phonon masers are discussed. Some experimental applications and results are presented. (R.E.U.)

20317 THE SYNTHESIS OF PULSE FORMERS WITH PREDETERMINED LIMITS OF TIME AND FREQUENCY. J. Jess. Thesis, Aachen, Technische Hochschule, 1962. 97p. $2.00(Gmelin, AED-DISS. 62-678). (In German)

Characteristics of optimal pulse filters are discussed. Calculations with Chebyshev approximations for frequency and time using iterative methods are described. Results of calculations with a digital computer are given. (Gmelin Inst.)

20318 EXPERIMENTAL DETERMINATION OF PHASE SHIFT OF ELECTRON WAVES BY THE MAGNETIC VECTOR POTENTIAL. K. Grohmann. Thesis, Berlin, Technische Hochschule, 1963. 81p. $2.00(Gmelin, Technische Hochschule, AED-DISS. 63-315). (In German)

The equations for phase shift of electron waves are discussed. The design of an electron interferometer with an arrangement for the generation of a magnetic flux is described. Intensity distributions in interference diagrams are asymmetric due to magnetic phase shift. Results are in agreement with theoretical predictions. (Gmelin Inst.)

20319 THE USE OF AN ELECTRON MICROSCOPE FOR DEMONSTRATION OF LATTICE PLANES IN THIN SINGLE CRYSTALS AND FOR THE DETERMINATION OF THE LATTICE CONSTANTS USING SMALL AREA DIF-

FRACTION. W. C. T. Dowell. Thesis, Berlin, Universität, 1963. 96p. $2.00(Gmelin, AED-DISS. 63-287). (In German)

The minimal distance of lattice planes that can be separated with an electron microscope is investigated. Methods for the determination of lattice constants using small area diffraction are described. Sources of errors are discussed. The design of special sample carriers with large transmission areas is described. (Gmelin Inst.)

20320 INSTRUKTSI I. PO MONTAZHU I EKSPLYATATSII RADIOIZOTOPNOGO PLOTIOMERA ZHIDKOSTI S ZAVODSKII OBOZNACHENIEM PZHR-2 M. (Installation and Operation of Radioisotopic Densitometer for Liquids). A. Shtan' and K. Smirnov. USSR, State Construction Ministry, 1963. 29p.

Safety rules and technical instructions are given for the installation and operation of a radiometric densitometer for liquids. Design and specifications are included. (R.V.J.)

20321 TRANSIENT RADIATION EFFECTS IN COMPONENTS AND CIRCUITS. William A. Bohan (International Business Machines Corp., Owego, N. Y.). 11p. (CONF-482-1)

From Radiation Effects Conference, Syracuse, N. Y., June 1963.

The effects of radiation pulses are described for transistors and capacitors and interpreted in terms of semi-empirical models. These and other effects are then applied to the analysis of switching circuit behavior under a pulse of radiation. Some basic considerations on component selection and circuit design practice that will reduce the sensitivity of circuits to transient radiation effects are also included. (P.C.H.)

20322 METHOD AND APPARATUS FOR DETERMINING THE REFLECTION COEFFICIENT OF MATERIAL. (to Stamicarbon N.V.) British Patent 955,122. Apr. 15, 1964. Priority date Nov. 30, 1960, Netherlands.

A method and apparatus are described for testing a sample of material to determine its radiation reflecting properties, such as in the x-ray scattering analysis of coal for its ash content. In the method, the radiation beam is emitted obliquely onto the sample and a standard, and the reflected radiation is intercepted by a detector and used to yield a signal indicative of the radiation reflecting properties of the sample. The sample and standard surfaces exposed to the radiation are located adjacent to each other, and a chopper operates in the radiation beam so that the surfaces are exposed alternately. Using this method, it is possible to measure the ash content of a coal sample to within 0.1% in 30 to 40 sec, as compared to 15 min required with other methods. (D.L.C.)

20323 APPARATUS FOR MEASURING COATING AMOUNTS. Walter James Dobbins (to American Can Co.). U. S. Patent 3,130,303. Apr. 21, 1964. Filed Nov. 2, 1960.

A method and an apparatus are described for measuring the amount of coating being applied to a substrate (sheet) by a conventional roller coating apparatus. In the method, beta rays are directed against one of the rollers, and the back-scattered radiation is detected and used as a measure of the coating thickness. This roller must be perfectly round and non-eccentric, and its surface must be covered by a nonmagnetic layer, preferably of chromium. The method is applicable to organic and other coatings whose atomic number differs substantially from that of the nonmagnetic layer on the roller. The method is an improvement of that described in U.S. Patent 3,019,336. (D.L.C.)

20324 RADIOACTIVE SELECTOR CIRCUIT FOR CONTROLLING THE LEVEL OF MATERIAL BETWEEN A SOURCE AND SELECTOR. Clifford Kenneth Beswick and Gordon William Whitehurst (to Simon-Carbes Ltd.). U. S. Patent 3,130,311. Apr. 21, 1964. Priority date Sept. 15, 1958, Great Britain.

A control device is designed for the maintenance of the level of fluent materials in a container. The device comprises a radiation source, a Geiger-Mueller tube, a blocking oscillator-type circuit to be triggered by the Geiger-Mueller pulses, and means for energizing an indicator or control circuit in accordance with the oscillator output. The radiation source and Geiger-Mueller tube are located so that the radiation beam is attenuated by the fluent material when it is at the proper level. (D.L.C.)

Radiation Detection

Refer also to abstracts 19818 and 20101.

20325 (AROD-2427:1) THE NATURE AND INTERACTIONS OF HIGH-ENERGY FUNDAMENTAL PARTICLES. Final Scientific Report for the Period Ending June 30, 1963. R. W. Thompson (Chicago. Univ.). 21p.

The design and status of a large detector array for cosmic-ray investigations on the production, nature, and interactions of elementary particles at energies of $\gtrsim 10^{12}$ Bev are discussed. A graphite-plate spark chamber at the top of the array provides visual detection, and a magnetic Wilson chamber beneath the spark chamber will determine the charge sign and momentum of charged particles. Photons will be detected by a lead-plate cloud or spark chamber beneath the Wilson chamber, and energies will be measured with a Dobrotin ionization calorimeter at the bottom of the array. (D.C.W.)

20326 (BNL-7853) STUDY OF SURFACE EFFECTS IN THICK LITHIUM-DRIFTED SILICON RADIATION DETECTORS. J. Llacer (Brookhaven National Lab., Upton, N. Y.). [Feb. 24, 1964]. Contract [AT(30-2)-Gen-16]. 28p. (CONF-182-10)

From the 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

Leakage current in lithium drifted detectors is a very sensitive function of surface condition. The relevant surface phenomena were investigated. N-type conduction layers were found which extended from the lithium-rich side across the depleted material to an inversion layer on the p-type material, at the other end of the detector. Regions of high electric field exist in the vicinity of the i-p boundary. By measuring surface potentials and solving Laplace's equation in the depletion region, electric field configurations were calculated as well as net charge concentration at the surface. Collection probability for pairs generated in the surface layer was measured and found to be independent of bias above $V_B \simeq 1$ volt. A model for the generation of surface currents is proposed. Measurements indicate that most of the surface current is created in the region of high field. Finally, the number of occupied surface states was computed and found to be, at low bias, on the order of 10^4 times the number of atoms at the Si surface. (auth)

20327 (BNL-7880) A BEAM PROFILE INDICATOR WITH SOLID STATE DETECTORS. Luis Tepper, G. L. Miller, and T. Kycia (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 20p. (CONF-182-5)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963.

An instrument built to provide a display of the profile of secondary beams from high-energy accelerators is described. It can handle 10^5 particles/cm^2/pulse, assuming

a 20 msec spill. The profile is measured by an array of 32 semiconductor detectors, 4 mm apart and arranged in the form of a cross. The detectors count the individual impinging particles. The total numbers of counts on each detector are fed continuously to a multichannel scaler, which in turn delivers an analog live display and a digital printout. Details of the electronics and methods of fabrication of the detectors, as well as their problems, are discussed. (auth)

20328 (BNL-7932) ERROR MATRIX FOR BUBBLE CHAMBER TRACK MEASUREMENTS. William J. Willis (Brookhaven National Lab., Upton, N. Y.). Aug. 3, 1959. Contract [AT(30-2)-Gen-16]. 16p.

A matrix is presented for the assignment of errors to track measurements. The matrix is symmetric, with the diagonal elements representing the variances in the track parameters and the other elements giving the covariances. Distortion errors are discussed. (D.L.C.)

20329 (BNL-7933) REMARKS ON CURVATURE AND ANGLE MEASUREMENTS IN A HYDROGEN BUBBLE CHAMBER. B. Gregory (Brookhaven National Lab., Upton, N. Y.). May 1958. Contract [AT(30-1)-Gen-16]. 22p. (Handwritten MS Copy).

The calculation of errors in least squares and angular measurements and of errors due to scattering is considered. Approximate formulas are given. A method is given for calculating the momentum and the tangent direction at the apex of the track in a hydrogen bubble chamber. (D.L.C.).

20330 (CEA-2388) SPECTROMETRE UTILISANT LES DETECTEURS A SEMICONDUCTEUR ETUDE ET APPLICATIONS. (A Spectrometer Using Semi-Conductor Detectors: Study and Applications). Georges Roux (France. Commissariat a l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 79p.

The low average energy, 2.5 to 3.5 ev, required to produce one hole-electron pair in a semiconductor allows the accurate measurement of the energy of the ionizing particles. A high resolution spectrometer has been built using semiconductor detectors. The limit of resolution, due to electronics associated to the detector, to the detector itself, and to the source of particles is studied here. The present practical limit of resolution of the spectrometer is 1700 elementary electric charges (full width at half maximum of a ray of a spectrum) or 6 kev in terms of energy lost by a particle in a silicon detector. The physical resolution usually obtained is 20 kev (0.33 per cent) with α particles of the ^{212}Bi (6.087 Mev). It very much depends on the kind of detector used. Some results, concerning the background of the detectors and limit of measurements for low energies, are given. Various applications are presented: β spectrometry, γ and x spectrometry, spectrometry of mixtures of α radioactive elements, and collection of α spectra. (auth)

20331 (KR-64(Sect.X)) COINCIDENCE ARRANGEMENTS WITH SCINTILLATION CRYSTALS. G. Baeckstroem (Uppsala Univ.). 11p.

Coincidence techniques for achieving high resolution in scintillation gamma spectroscopy using NaI phosphor are reviewed. The applicability of the techniques at high (above about 1 Mev) and low (below 1 Mev) energy is analyzed. (T.F.H.)

20332 (KR-64(Sect.XII)) ELECTRON SPECTROSCOPY CONNECTED WITH NEUTRON CAPTURE. G. Baeckstroem (Uppsala Univ.). 9p.

Instruments for electron-spectroscopic uses in conjunction with neutron reaction studies are outlined, and their performance in various experimental configurations is noted. (T.F.H.)

20333 (KR-64(Sect.XX)) CRYSTAL SPECTROMETERS FOR THE MEASUREMENT OF NEUTRON-CAPTURE GAMMA RAYS. O. Schult (Munich. Technische Hochschule and Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). 14p.

The characteristics of flat-crystal and bent-crystal gamma spectrometers for use in high-resolution applications are reviewed. (T.F.H.)

20334 (KR-64(Sect.XXXI)) SEMICONDUCTOR DETECTORS. B. Åstroem (Sweden. Kungliga Vetenskapsakademien. Nobelinstitutet for Fysik, Stockholm). 24p.

A lecture-type survey is presented of semiconductor radiation detectors, with emphasis on their uses for neutron detection. (T.F.H.)

20335 (NP-13840) CONTRIBUTION A L'ETUDE DES COMPTEURS A SCINTILLATEURS LIQUIDES (theses). (Contribution to the Study of Liquid Scintillation Counters (thesis)). Gilbert Laustriat (Strasbourg. Université). [nd]. 121p.

After a summary of the spectral properties of various scintillators, the effect of diverse experimental conditions (preparation of the liquid scintillator, geometry of the scintillator, and scintillator thickness) on the scintillator yield was studied. The complex problem of the effect of temperature on the photomultiplier and the scintillator was then investigated. Various aspects of the inhibiting effect of oxygen on the efficiency of scintillators are examined. Indications on the processes taking part in the energy transfer in scintillators were obtained from the study of the effects of temperature and oxygen. A device for the detection and measurement of soft β particles, using liquid scintillators, is described, and its principal characteristics are given. (tr-auth)

20336 (NP-13851) SUR LA SENSIBILITÉ DES CRISTAUX DE AgBr DANS LES ÉMULSIONS IONOGRAPHIQUES (theses). (The Sensitivity of AgBr Crystals in Ionographic Emulsions (thesis)). Marie-Cecile Lefevre-Le Gentil (Paris. Université). 1960. 26p.

The Gurney-Mott theory and the Mitchell theory on the formation of the latent image and the effect of photographic sensitizers were reviewed. In conformance with the Gurney-Mott theory the granulation of a particle track was determined, using the Berriman theory but introducing the effect of fluctuation on the specific loss of energy. A preliminary evaluation was made of the number of positive holes produced in order to obtain an order of magnitude. The loss of energy of the incident particle was determined first in the different constituents of the emulsion and then in the electrons of the different layers of the two atoms of AgBr. The quantum theory and classical theory were used to determine the energy of the electrons emitted during the interactions of the incident particle with the crystal. The results obtained by the two methods were compared and extended to hydrogenoid atoms. The sensitivity of crystals was defined. The case of the track produced by an incident proton crossing the Br^- and Ag^+ ions of a G5 emulsion was studied. The energy distribution of all the electrons ionized along the trajectory of the incident particle was calculated. The sensitivity of the AgBr crystal of the G5 emulsion was studied first at the ionization minimum and then at variable energies. The theoretical and experimental granulations of the corresponding track were compared in this case. Experimental results on hypersensitive emulsions were considered in conclusion. (J.S.R.)

20337 (NYO-2553-1) GEOMETRICAL AND ATTENUATION CORRECTIONS FOR A TWO CRYSTAL WHOLE-BODY COUNTER; BODY SCANNING WITH AN 8 × 4-INCH SODIUM IODIDE CRYSTAL. Final Report. Gerald J. Hine, Sebastian Genna, and Belton A. Burrows (Boston Univ. School of Medicine and Veterans Administration Hospital, Boston). [nd]. Contract AT(30-1)-2553. 29p. (CONF-362-2)

From the 2nd Symposium, Radiochemistry in Man, Chicago, Sept. 1962.

Design features of a whole-body counter are described. The counter employs two 8- × 4-in. NaI crystals inside a steel room, a scanning system to utilize the increased sensitivity of the large crystals, and collimators with a 5-in. focal distance. The system allows the estimation of radioactivity in vivo independent of its distribution within the human body by the use of geometrical and γ-absorption corrections. Iodine-131 scans, comparable to those obtained with a smaller moving crystal, were obtained by one crystal placed inside a 3-in.-thick Pb shield with a focusing head at the side of the crystal face. The advantages of using the larger crystals include increased focal distance, higher sensitivity, and adaptability to high energy γ emitters. (C.H.)

20338 (PAN-469/I) AN ELECTRONIC DEVICE IMPROVING THE RESOLUTION OF THE TIME-OF-FLIGHT SPECTROMETER WITH MANY-LAYER TRAY OF COUNTERS. M. Moszyński, A. Turos, and Z. Wilhelmi (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Oct. 1963. 12p.

The application of the many-layer tray of counters in a time-of-flight slow neutron spectrometer increases the luminosity of the spectrometer but simultaneously deteriorates its time resolution. This undesirable effect results from the time delay between the pulses produced in various layers of the tray. To overcome this difficulty a simple electronic device has been constructed. Its principle of operation is as follows: the pulses from the extreme layer come to the time analyzer directly, whereas the pulses produced in the other layers are automatically delayed according to the velocity of the neutrons which produce those pulses. The application of the correcting device described improves the time resolution of the spectrometer considerably. (auth)

20339 (TID-20504) PREDICTION AND MEASUREMENT OF NEUTRON CHOPPER BURST SHAPES (thesis). John Marland Carpenter (Michigan. Univ., Ann Arbor). 1963. Contract AT(11-1)-917. 108p.

A method is developed for predicting the number of neutrons passed by a system of multiple rotors in a chopper configuration as a function of time. The analysis accounts for the spatial and angular distribution of the beam passed through the system. The neutron trajectories are specified in terms of angles φ and ψ; φ is the angle between the x-axis and the projection of the trajectory direction against the x-y plane and ψ is correspondingly measured in the x-z plane. The Michigan Research Reactor chopper was used in experimental testing of the method. (R.E.U.)

20340 (TID-20525) [DOSIMETRY IN HUMAN RADIOEPIDEMIOLOGY, WITH SPECIAL REFERENCE TO SKELETAL DOSE RATES IN THOROTRAST CASES]. Progress Report. (International Atomic Energy Agency, Vienna.). [1964]. Work Performed under Contract IAEA/US. 23p.

The calibration of a whole-body radiation counter is discussed. Data are tabulated on the content of ^{228}Ra and ^{212}Pb in 11 individuals with a history of Thorotrast injection. Preliminary data are included from an epidemiological study of Thorotrast cases. (C.H.)

20341 (TID-20564) THE ULTRA SOFT ELECTRONIC COMPONENT OF THE ENVIRONMENTAL RADIATION. Interim Technical Report. Joseph G. Reisinger (New York Univ., New York. Graduate School of Arts and Sciences). Feb. 1964. Contract AT(30-1)-1704. 90p.

A detector capable of separating the low energy ionizing radiation from the nonionizing component of the environmental radiation was developed. The detector consists of a very-thin-walled continuous-flow proportional counter in coincidence with a NaI scintillation spectrometer. The detector was employed to evaluate the intensity and spectral distribution of the electronic component of the environmental radiation from 130 kev to 3.6 Mev. By adding various thicknesses of aluminum above the detector assembly, it was possible to further divide the electronic component into its equilibrium and nonequilibrium subcomponents. Evaluation of the beta activity due to the decay products of radon, normally present in the atmosphere, indicates that the nonequilibrium component may be attributed primarily to this source. The measurements were made 170 feet above sea level. (auth)

20342 (UCRL-10781) HIGH-RESOLUTION GAMMA-RAY SPECTROMETRY FROM 20 TO 650 Mev. Gilbert D. Mead, Robert J. Cence, and Don L. Lind (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 18, 1963. Contract W-7405-eng-48. 24p.

Two pair spectrometers were developed to measure gamma spectra over a range from 20 to 650 Mev with a resolution of ±5 to 8%. One is a conventional 180° spectrometer to measure the lower energies; the other, for high energies, utilizes a circular geometry. Expressions for the absolute efficiency are derived which consider the geometry, magnetic field, pair-production cross section, and vertical electron scattering. The effects of geometry and radiation straggling on the resolution function are considered. These factors are then used to provide the proper normalization for the experimental spectra over the range of energies measured. The counting data are stored in a magnetic-core device, then read out on punched cards. A computer program analyzes the data and makes all the necessary corrections and subtractions. The spectrometers were used in experiments with natural pions at cyclotron energies. (auth)

20343 (UCRL-11147) EVALUATION OF THE C-70045A HIGH-SPEED PHOTOMULTIPLIER. Meir Birk, Quentin A. Kerns, and Robert F. Tusting (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 19, 1964. Contract W-7405-eng-48. 21p. (CONF-182-11)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963.

Measurements were made of the time spread, pulse response, and other characteristics of the C-70045A 14-stage photomultiplier which was developed for high-speed timing applications with scintillation and Čerenkov radiation detection. Rise times and time jitters are given. Some measurements of the scintillation decay time of two plastic scintillators are reported. (D.L.C.)

20344 (UCRL-11261) AN AUTOMATIC LITHIUM DRIFTING APPARATUS FOR SILICON AND GERMANIUM DETECTORS. Fred S. Goulding and W. L. Hansen (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 8, 1964. Contract W-7405-eng-48. 9p. (CONF-182-8)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

A drifting apparatus is described which automatically controls the temperature of the detector that is being drifted to maintain the leakage current at a preselected value. While drifting proceeds, a continuous measurement is made of the distance of the Li-drifted region from the opposite face of the wafer. When the drifted region reaches 30 mil or less from the back of the wafer, a meter indicates the thickness of the undrifted region; and, when this thickness falls below a preselected value, the temperature of the detector is automatically reduced to room temperature. The technique was applied to the manufacture of Li-drifted Si detectors with excellent results. The application of the technique to Li-drifted Ge gamma detectors is also discussed briefly. (auth)

20345 A FAST-SLOW COINCIDENCE SYSTEM EMPLOYING A MULTICHANNEL TIME DISPLAY. R. B. Tomlinson and R. L. Brown (Atomic Energy of Canada Ltd., Chalk River, Ont.). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 28-38(Apr. 1964).

A versatile, solid-state fast-slow coincidence system is described which is used with large NaI(Tl) scintillators and XP1040 photomultipliers. A multichannel time display is provided, which consists of a time-to-amplitude converter of the "start-stop" type and a standard 100-channel kicksorter. The calibration of the time analyzer can be varied from 1 to 0.1 nsec per channel. In addition to showing the time spread, the display indicates the coincidence resolving time which is variable from 1 to 100 nsec by means of front panel helipots. The electronic time jitter of the system, as measured with a fast pulser is less than 0.2 nsec. A resolving time of 8 nsec gives 95% coincidence efficiency for coincidences between the annihilation radiation photopeaks from ^{22}Na. (auth)

20346 DIGITAL PRINTOUT SYSTEM FOR WHOLE-BODY SCANNER. J. W. Beattie and G. Bradt (Sloan-Kettering Inst., New York). IRE (Inst. Radio Engrs.), Trans. Bio-Med. Electron., 8: 24-8(Jan. 1961).

A scintillation scanner was developed for large-area mapping of high-energy γ-emitting radioisotope distributions in patients undergoing metabolic studies. An unusual method of operation uses a solenoid-operated electric typewriter as a digital plotter. A three-figure entry of the count observed at each position of the stepwise scan pattern is typed with a decimal point locater to allow five-figure dynamic range. Three numeric type alphabets are incorporated to print each entry without carriage advance. The platen and carriage are synchromotor driven by the scanner. Scan index spacing down to $^{3}/_{16}$ in. is possible over 24-in. maximum scan widths. The complete scan is a full-scale quantitative planar map in the form of a matrix through which isocount contours may be located by inspection. The electronic system necessary is described in detail. Counts are accumulated in the scaler or decade counter, while the timer is timing, in six binary coded decade scaling strips. The first three significant figures are selected by a sequential relay circuit and switched to the appropriate typewriter key solenoids. One selects the decade strip, while another selects the typewriter numeric alphabet. Both are back acting types. The code converter is a triode-driven four-relay tree with one of 10 contact closures selected for each binary coded input. The entire printout time is $^{1}/_{2}$ sec and the indexing time one to three sec, depending upon spacing. This instrument was specifically designed for metabolic studies with high-energy γ-ray emitters, such as ^{47}Ca which is used in patients with bone lesions, but it is well adapted to all high-energy γ scanning. (BBB)

20347 PORTABLE FOUR-CHANNEL SPECTROMETER. H. Heuser and H. Schneider (Universität, Giessen, Ger.). Kerntechnik, 6: 105-7(Mar. 1964). (In German)

A scintillometer equipped with transistors was developed. It enables energy measurements of γ radiation in open area by single-channel and four-channel operation. The construction and the operation mode of the instrument are described. Some measurements made during operational tests are given. (auth)

20348 A COAXIAL-SYMMETRICAL FLOW SPARK COUNTER FOR DETECTING CARBON DIOXIDE AND THERMAL NEUTRONS. W. Burkhardt and H. Erler (Institut für Angewandte Radioaktivitat, Leipzig). Kerntechnik, 6: 108-11(Mar. 1964). (In German)

A method is described for measuring small quantities of carbon dioxide, additionally present in the air, with the aid of a flow spark counter. The detection sensitivity of a boron carbide cathode spark counter for thermal neutrons can be improved by this effect, caused by the carbon dioxide. (auth)

20349 SEMICONDUCTOR PARTICLE DETECTORS. PART I. A. Hess and H. Schneider (Justus-Liebig-Universität, Giessen, Ger.). Kerntechnik, 6: 116-18(Mar. 1964). (In German)

Defect conduction of a semiconductor, p-n transitions in semiconductors, extent of space charge region, manner of operation of semiconductor detectors, size of the initial pulse in counting, rise time and fall time of the initial pulse, and energy resolution are discussed. (M.C.G.)

20350 NEUTRON AND GAMMA-RAY DISCRIMINATION IN ORGANIC SCINTILLATORS. Osamu Tanaka (Mitsubishi Electric Mfg. Co., Amagasaki, Japan). Mitsubishi Denki Lab. Rept., 4: 101-15(Jan. 1963).

A new type of fast-neutron detector based on the principle particle discrimination by pulse shapes of scintillation decays is applied to nuclear physics experiments as a simple and high-efficiency detector. The neutron and gamma-ray discrimination for different scintillators and photomultipliers was observed using the space charge effect in the photomultiplier. The space charge effect and the fluctuation of the space-charge-saturated pulse height were discussed. The efficiency of the neutron detector was about 10 percent at a neutron energy of 3.65 Mev, while the gamma detection efficiency was negligibly small. The minimum energy of the detectable neutron was about 0.5 Mev. As an application of the detector, the neutron total cross sections of light nuclei were measured by the transmission method. The difference of the optical spectra between fast and slow components in the scintillation by gamma rays was not observed. (auth)

20351 CdS γ-RAY DETECTOR. T. Yamashita, S. Kitamura, and Y. Amano. Natl. Tech. Rept. (Matsushita Elec. Ind. Co., Osaka), 8: 436-42(Oct. 1962). (In Japanese)

The feasibility of γ-dosage rate determination by measuring γ-ray-induced conductance of CdS was studied. CdS was used in single crystals and in sintered layers. The CdS detector had the advantage of small size and simplicity of the external circuit required. The maximum dosage rate sensibility was 0.1 r/min. The response time $\tau_{1/e}$ depends on the dosage rate, i.e., 20 sec at 10 r/min and 3 min at 1 r/min. An increase of photoconductivity caused by radiation damage was observed when exposed to more than 10^7 r at a dosage rate of 10^3 r/min. This increase was not observed at a dosage rate of less than 10^3 r/min. (auth)

20352 MEASUREMENT OF SAMPLE QUENCHING OF LIQUID SCINTILLATOR SOLUTIONS WITH X-RAY AND GAMMA-RAY SOURCES. Donald L. Horrocks (Ar-

gonne National Lab., Ill.). Nature, 201: 78-9(Apr. 4, 1964).

The use of relative pulse heights of Compton peaks of low energy (<60 kev) x and γ rays for measuring the degree of quenching in liquid scintillators is described. Graphs of examples are given. (M.J.T.)

20353 A WEDGE-SHAPED SCINTILLATION COUNTER WITH HIGH SPATIAL RESOLUTION. D. W. G. S. Leith (Glasgow Univ. and CERN, Geneva). Nucl. Instr. Methods, 25: 224-9(Jan. 1964).

A new instrument for the measurement of the spatial position of a particle is described. The pulse height analysis of the output of a simple wedge-shaped plastic scintillation counter has been used to provide information on the spatial position of particles passing through the counter. A resolution of 0.2 ± 0.02 mm was obtained. Various applications of this counter are also discussed. (auth)

20354 CONSTRUCTION AND PERFORMANCES OF SILICON SURFACE BARRIER DETECTORS. F. Cappellani and G. Restelli (Euratom, Ispra, Italy). Nucl. Instr. Methods, 25: 230-6(Jan. 1964).

Some considerations in the construction of surface-barrier detectors are reported. Performances of the detectors constructed and their applications to alpha spectroscopy have been examined. (auth)

20355 A LITHIUM-DRIFTED SILICON SURFACE-BARRIER DETECTOR FOR NUCLEAR RADIATIONS. G. Dearnaley (Atomic Energy Research Establishment, Harwell, Berks, Eng.) and J. C. Lewis. Nucl. Instr. Methods, 25: 237-43(Jan. 1964). (AERE-R-4335)

A detailed description is given of a technique for the preparation of silicon junction detectors, using the lithium ion-drift process to achieve sensitive volumes several millimeters in thickness. By forming a surface-barrier on such compensated material, window thicknesses below 1 μ have been easily obtained. Experimental results are presented. Energy resolutions better than 60 kev for alphas and protons, and 25 kev for betas, have been obtained at room temperature. (auth)

20356 A FAST COINCIDENCE PREAMPLIFIER FOR SOLID-STATE RADIATION DETECTORS. H. Wahl (Universität, Hamburg). Nucl. Instr. Methods, 25: 247-52(Jan. 1964).

A preamplifier allowing both good time and energy resolution for the particle detection with p-n junctions is described. Corresponding to one coincidence channel, 0.22 and 1 nsec time resolution for α particles of 10 and 1 Mev respectively were obtained using a small-area surface-barrier detector with 15 nsec rise time. The limitation of the time resolution due to electronic noise is discussed. (auth)

20357 IRRADIATION DAMAGE EFFECTS IN SILICON SURFACE BARRIER COUNTERS. G. G. George and E. M. Gunnersen (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 25: 253-60(Jan. 1964).

The effects of 14 Mev neutron and 2 Mev electron irradiations on surface barrier counters have been related to the permanent damage effects of identical irradiations on the carrier lifetime, Hall coefficient, and mobility of bulk silicon taken from the same n-type ingots. A tentative discussion of mechanisms causing the observed counter behavior is given, and the suggestion is made that irradiation damage followed by cooling may provide useful thick counters of constant capacity. This is made possible by the fact that for this special high purity silicon, irradiation can raise the resistivity well before degradation of carrier lifetime destroys the resolution. (auth)

20358 A SIMPLE PULSE VOLTAGE DIVIDING CIRCUIT (RATIO CIRCUIT) AND ITS APPLICATION TO THE FISSION FRAGMENTS STUDY. M. Tsukuda (Rikkyo Univ., Tokyo). Nucl. Instr. Methods, 25: 265-8(Jan. 1964).

A simple transistorized pulse voltage dividing circuit based on a sampling technique is described. The circuit makes use of the fact that the voltage rise of a capacitor is a linear function of V_1/V_2 when it is charged with a constant current which is proportional to one voltage input V_1 during a time t which is inversely proportional to another voltage input V_2. Input pulse voltages are required to be the flat topped positive input pulses of some 10 μs duration and 5 to 20 volt in amplitude. The linearity of the circuit for a constant value of V_2 was better than 2%. The circuit was used for the measurement of the mass distribution of the fragments resulting from the thermal neutron induced fission of ^{235}U with the aid of a back-to-back arrangement of Si surface barrier type solid detectors. (auth)

20359 A METHOD OF EXTENDING THE ENERGY RANGE OF THE HELIUM-3 NEUTRON SPECTROMETER. W. K. Brown (Univ. of California, Livermore). Nucl. Instr. Methods, 26: 1-6(Feb. 1964). (UCRL-6911(Rev. 1))

A method of extending the energy range of the helium-3 neutron spectrometer is described. The method provides the instrument with the capability of analyzing continuous neutron spectra that include neutrons of energies in excess of 1 Mev. Presented is a description of the "wall-less" counter constructed as part of the project, the formulation of the problem of calculating the interfering helium-3 recoil spectra by analyzing the true (n,p) spectrum, and a verification of the method utilizing a monoenergetic source of neutrons. An outline of the computer code programmed to infer and unfold the interfering spectra is given. (auth)

20360 A 4π BETA SPECTROMETER. R. E. Snyder and G. B. Beard (Wayne State Univ., Detroit). Nucl. Instr. Methods, 26: 31-3(Feb. 1964).

A 4π scintillation spectrometer suitable for measuring beta spectra is described. It consists of a thin liquid source sandwiched between two plastic scintillators. A technique has been devised for making thin uniform source layers. Fermi plots for ^{35}S and ^{131}I and the spectrum of the 163-kev internal conversion electrons from ^{114m}In are shown to demonstrate the performance capabilities. (auth)

20361 A GEIGER COUNTER WITH POST-ACCELERATION. W. Mehlhorn and R. G. Albridge (Vanderbilt Univ., Nashville). Nucl. Instr. Methods, 26: 37-41(Feb. 1964).

A Geiger counter with post-acceleration has been constructed for use with the Vanderbilt iron-free spectrometer. Electrons focused on the spectrometer exit slit are accelerated by an electric field before penetrating the counter window. The accelerating potential is variable from 0 to 8.5 kv. A variable decelerating potential (0 to 300 v), positioned in front of the accelerating field, rejects very low energy electrons, reducing the background. With the accelerating potential, electrons with initial energies of less than 1 kev can be detected with ~100% efficiency with counter windows thick enough (>30 μg/cm²) to maintain reasonable counter pressures (4 cm Hg) without leaking or breaking. Electrons with initial energies of 0.1 kev have been measured with window transmissions of 95%. (auth)

20362 DISCRIMINATION OF LOW ENERGY PROTONS AND ALPHA PARTICLES IN ILFORD KO NUCLEAR EMULSIONS. V. Paić and M. Paić (Institut "Ruder Boskovic," Zagreb). Nucl. Instr. Methods, 26: 42-4(Feb. 1964).

Studying the possibility of discrimination of low energy proton and alpha particle tracks, we examined the grain density distribution of 2.7-Mev proton and 4.5-Mev alpha particle tracks in Ilford KO nuclear emulsions 200 μm thick developed with an amidol developer in a two-stage development. It is possible to discriminate compietely and with certainty the two particles. The mean grain density of proton tracks is (0.48 ± 0.14) grains/μm and that of alpha particle tracks is (1.38 ± 0.13) grains/μm. The energy resolution of alpha particles amounts to 8.96%. (auth)

20363 TIME-OF-FLIGHT ENCODER WITH VARIABLE BAND WIDTH. J. Thenard and G. Victor (Centre d'Etudes Nucléaires, Saclay, France). Nucl. Instr. Methodes, 26: 45-50(Feb. 1964). (In French)

This paper deals with a time-of-flight encoder. It is mainly intended for neutron velocity measurements by the time-of-flight method. The special peculiarity of the equipment described, is that the time-interval durations, which are used as basis of the measurement, may be modified during the measurement cycle according to a program selected on a matrix board. This property leads to the best use of the encoder capacity, for on one hand, it allows to get a nearly constant resolution and on the other hand, to fit it to each part of the time spectrum to be investigated. Time-interval durations ΔT used as basis for time-measurements are 50, 100, 200, 400, 800, 1600, and 3200 nsec. Maximum capacity of the address-scaler is 65.535 channels. Number of allowed changes of the time interval ΔT within a cycle is 16. Minimum delay between two changes is 3.2 μs. (auth)

20364 A SOLID-STATE SPECTROMETER FOR MEASURING THE DISTRIBUTION OF CHARGED PARTICLES IN AURORAE. J. Czekajewski (Inst. of Physics, Uppsala), P. A. Tove, and Z. Grabowski. Nucl. Instr. Methods, 26: 66-70(Feb. 1964).

The energy spectrum is obtained by scanning the pulse-height distribution from solid state detectors, using a discriminator biased with a stair-case voltage. The working principle of the spectrometer and the construction of a fast-response log-rate-meter are described. The equipment was built for a rocket to be launched in connection with the research program of Kiruna Geophysical Observatory. (auth)

20365 SPECTROMETERS FOR FAST NEUTRONS FROM NUCLEAR REACTIONS AND FROM COLLIMATED BEAMS. R. Potenza and A. Rubbino (Università, Catania, Italy). Nucl. Instr. Methods, 26: 93-103(Feb. 1964).

Two fast neutron spectrometers are described and experimentally checked for absolute measurements of energy spectra of neutrons emitted in nuclear reactions and of neutrons from collimated beams. The recoil protons ejected from large radiator sheets are detected by junction detectors. A good signal-to-noise ratio is obtained by screening the junction detector against direct neutrons. A satisfactory compromise between efficiency and resolving power is realized. (auth)

20366 LOW NOISE SOLID STATE AMPLIFIERS FOR SEMICONDUCTOR DETECTORS. L. G. Jonasson (Inst. of Physics, Uppsala). Nucl. Instr. Methods, 26: 104-8(Feb. 1964).

The use of a tunnel diode and of a field effect transistor in the input stage of an amplifier for semiconductor detectors is discussed. The noise performance of the amplifiers is calculated and measured data are given. A simple and stable field-effect transistor amplifier giving a resolution of 5 kev (FWHM) is described. (auth)

20367 TEMPERATURE REGULATOR FOR A 9-LITER LIQUID HYDROGEN BUBBLE CHAMBER. A. Barna (Univ. of Chicago). Nucl. Instr. Methods, 26: 109-16(Feb. 1964).

A temperature regulator servo system with a long-term stability of better than 10×10^{-3}°K at 28.5°K is described. Design considerations, components, and construction techniques are discussed. (auth)

20368 SOME CONSIDERATIONS ON THE PROPER USE OF THE POLARIZED NEUTRON SPECTROMETER. A. Paoletti and F. P. Ricci (CNEN, Rome). Nucl. Instr. Methods, 26: 125-31(Feb. 1964).

Some simple criteria for a proper use of a r-f polarized neutron spectrometer are given. Flipping efficiency and intensity problems are discussed in terms of the possible experimental arrangements. The error evaluation of the method is given. Extinction and double-Bragg-scattering effects are briefly reviewed. (auth)

20369 A LIQUID-HYDROGEN ČERENKOV COUNTER. T. F. Zipf (Univ. of California, Berkeley), O. Chamberlain, J. A. Kadyk, and C. M. York. Nucl. Instr. Methods, 26: 132-6(Feb. 1964). (UCRL-10745)

Two models of a liquid-hydrogen Čerenkov counter have been constructed and tested. The first served as a prototype and was used to demonstrate the feasibility of the design concept and to show that liquid hydrogen does not give scintillation light of intensity comparable to that of Čerenkov light. The final version was designed for use in an experiment in which particles brought to rest in the hydrogen could give rise to relativistic electrons. In this second counter, the efficiency for detecting relativistic particles by their Čerenkov radiation in liquid hydrogen was measured by stopping μ^+ mesons in the hydrogen and detecting their decay electrons outside of the flask after a suitable time delay. An average detection efficiency of 75% was obtained, taken over the volume of the hydrogen. (auth)

20370 CONSTRUCTION OF A SPARK CHAMBER WITH TRANSPARENT METAL MESH. J. Banaigs (Laboratoire de Synthèse Atomiqe, et d'Optiqè Protonique, Ivry, France), J. Duflo, L. Goldzahl, B. Mouëllic, C. Delorme, R. Kiessler, and E. G. Michaelis. Nucl. Instr. Methods, 26: 137-40(Feb. 1964). (In French)

Spark chamber elements have been constructed using highly transparent wire mesh electrodes. The transparency of the electrodes permits photography of sparks through several elements. These can therefore be assembled into multi-element spark chambers in which a single photograph suffices to localize a particle track. Chambers based on this principle using up to four elements and ranging in size up to several square meters have been made and tested under different conditions. Performance data are given. (auth)

20371 THE USE OF FERRITE MEMORY CORES WITH MULTI-WIRE SPARK CHAMBERS. A. L. Aucamp, J. W. Koen, M. A. Meyer, J. J. van der Walt, and N. S. Wolmarans (Potchefstroom Univ. for C.H.E., South Africa). Nucl. Instr. Methods, 26: 167-72(Feb. 1964).

A new method of constructing multi-wire spark chambers is discussed. A study was made of the use of ferrite core memories in conjunction with these chambers. The accuracy of track location was found to be less than 1 mm. (auth)

20372 MEASUREMENT OF PROTON RANGES IN ILFORD K-1 EMULSION FOR ENERGIES BETWEEN 300 kev AND 1.2 Mev. P. W. Benjamin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 26: 179-81(Feb. 1964).

The ranges of protons of energies between 300 kev and 1.2 Mev in Ilford K-1 emulsion have been measured by observing the knock-on protons produced by irradiating the emulsion with mono-energetic neutrons of known energy. Only protons recoiling within a 10° forward cone about the direction of the neutrons were accepted and the range of each proton is corrected to that for 0° scatter. The density of the emulsion was measured and the ranges are adjusted to an emulsion density 3.815 g per cc. (auth)

20373 LOW-ENERGY GAMMA RAY SPECTROSCOPY. T. W. Nybakken and V. Vali (Boeing Scientific Research Labs., Seattle). Nucl. Instr. Methods, 26: 182(Feb. 1964).

Experimental results are presented indicating that Li-drifted Si radiation detectors can be used for low-energy (around 10 kev) gamma spectroscopy where resolutions on the order of 25% are acceptable. Cryogenic techniques are required to obtain these resolutions. (T.F.H.)

20374 APPLICATION OF HIGH RESOLUTION LITHIUM-DRIFT GERMANIUM GAMMA-RAY SPECTROMETERS TO HIGH ENERGY GAMMA-RAYS. G. T. Ewan and A. J. Tavendale (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nucl. Instr. Methods, 26: 183-6(Feb. 1964).

A description is given of the use of Li-drifted Ge detectors for high-resolution gamma spectroscopy. The detectors are used in the following manner: the photon enters the detector and annihilates into an electron–positron pair; the annihilation quanta escape from the detector; and the total energy of the electron–positron pair is lost in the detector. The detector thus records a peak at $E - 2m_0c^2$, where E is the photon energy and m_0 is the electron rest mass. The method is useful only at high photon energies. The detectors in this application have energy resolutions of about 0.13%. (T.F.H.)

20375 SEMICONDUCTORS, SCINTILLATORS AND DATA ANALYSIS. Margaret Beach Glos. Nucleonics, 22: No. 5, 50-53; 72(May 1964).

Lithium-drifted germanium detectors, doped with gallium or zinc, and providing deep depletion layers to give a linear relation between gamma energy and pulse height spectrum, are described. Their response to various gamma sources is graphed. Semiconductor properties—radiation damage and surface effects—of the detectors are discussed. Scintillator developments using calcium iodide crystals are reported. Progress in data analysis by combining computers and pulse-height analyzers in one system is considered. (M.J.T.)

20376 SEMICONDUCTOR DETECTORS—THEIR PROPERTIES AND APPLICATIONS. Fred S. Goulding (Univ. of California, Berkeley). Nucleonics, 22: No. 5, 54-61(May 1964).

Basic detector and system information is collected. Advantages of semiconductor over gas or scintillation detectors are given. Sensitive thickness and signal-to-noise ratio are discussed. Types of detectors—silicon-diffused junction, surface barrier, lithium-drifted silicon and germanium—are reviewed. Requirements of detector-amplifier systems are discussed, and circuit diagrams are given. Examples of the use of the various criteria for instrumentation choice are given for studies of fission fragments, high-energy reactions, alpha decay, beta spectrometry, and conversion electrons. (M.J.T.)

20377 COMMERCIALLY AVAILABLE SEMICONDUCTOR DETECTORS AND PREAMPLIFIERS. Nucleonics, 22: No. 5, 62-7(May 1964).

Tables of properties of commercial semiconductor detectors—silicon detectors: surface-barrier, phosphorus-diffused, totally depleted, and lithium-drifted; germanium lithium-drifted detectors—and preamplifiers are given. (M.J.T.)

20378 RECENT PROGRESS IN SPARK CHAMBER TECHNOLOGY. Arthur Roberts (Argonne National Lab., Ill.). Nucleonics, 22: No. 5, 68-71(May 1964).

New data on the accuracy of sampling chambers in momentum measurement and two developments in data readout systems are discussed. Properties of track delineating chambers and behavior in momentum measurements, clearing time, and ionization measurement are considered. Light-amplifying delineating chambers are mentioned. Gamma spectrometry using delineating chambers or shower detection is discussed. Track projection chambers are described briefly. (M.J.T.)

20379 MEASUREMENTS OF THE MIXED RADIATION FIELDS IN THE BR-2 REACTOR WITH THE HELP OF CALORIMETER PROBES. Rudolf Werz (CEN-EURATOM, Mol, Belg.). Nukleonik, 6: 28-33(Feb. 1964). (In German)

Material samples inside a reactor were heated by radiation absorption. An analysis of the mixed radiation fields showed that the heating is composed of three components, for which the thermal neutrons, fast neutrons, and gamma radiation are responsible. According to the kind of the chosen material sample, a definite radiation component can be more or less responsible for the heating. Calorimeter sondes allowed the radiation heating of the material samples to be measured and permitted, at the same time, dosimetry of the mixed radiation fields inside the reactor. As radiation detectors these sondes are of two types: adiabatic and isothermal calorimeters. For the Belgian reactor BR-2, a calorimeter sonde was developed, which contained two isothermal calorimeters with ^{235}U and aluminum as absorber. These detectors measured, essentially, the thermal neutron flux and the dose rate of the gamma radiation field. The measurement results obtained are discussed. The construction of other copies of this sonde, each with other absorber materials, such as beryllium and graphite, is foreseen. (tr-auth)

20380 4π-SCINTILLATION COUNTER FOR SMALL BETA ACTIVITY MEASUREMENTS. Ireneusz Natkaniec and Tadeusz Niewiadomski (Inst. of Nuclear Physics, Academy of Sciences, Krakow). Nukleonika, 8: 495-500 (1963). (In Polish)

The beta detector utilizes two photomultiplier tubes, each of which has a plastic scintillator coupled to it with a light pipe. The scintillators are separated by a thin air-gap for 4π geometry. The detectors are placed in a quick-opening shield, and their outputs are added and sent to an amplifier, discriminator, and counter. The characteristics of the detector are given as a function of voltage across the photomultiplier bleeder string, the gain of the amplifier, and the thickness of the scintillator pair. The thin scintillators were found to be extremely insensitive to gamma radiation in measuring ^{40}K activity, as determined by blocking out the beta activity with aluminum foils. The background of the detector arrangement is low and could be further improved by using thinner scintillators and an anticoincidence circuit. (TTT)

20381 SOURCES OF INSTABILITY OF THE WORK OF G-M END WINDOW COUNTERS. Kazimierz W. Ostrowski (Inst. of Technical Research, Polish Academy of Sciences, Krakow). Nukleonika, 8: 501-6(1963). (In Polish)

Instabilities in G-M counters of type BAT 1, BAT 2, and BAT 3/25 and 36 were considered. The precautions are listed by type of counter. The greatest precaution must

be taken with gas-quenching counters containing an organic gas. After about 10^7 total counts some of these counters may readily become photo-sensitive, therefore, the plateau is no longer flat and abnormally high count rates may occur. The precautions listed include break-in of the counter, initial testing and subsequent testing, avoiding high voltages by remeasuring the plateau, testing for small pulse heights, testing for abnormal pulse shapes, testing for imput capacitance, tests at high count rates, and background count tests. A table of 15 symptoms is given, along with several possible sources of trouble for each, and one or more precautions when applicable. (TTT)

20382 ON METHODICAL ERRORS IN EXPERIMENTS ON COINCIDENCE BEAMS. G. B. Erozolimskii, A. P. Onuchin, and A. G. Khabakhpashev (Inst. of Nuclear Physics, Academy of Sciences, Siberian SSR). Pribory i Tekhn. Eksperim., No. 1, 23-4(Jan.-Feb. 1964). (In Russian)

Experimental errors arising from the geometry of coincidence detectors are discussed. (C.E.S.)

20383 APPARATUS FOR POLARIZATION INVESTIGATION IN PROTON SCATTERING AT HIGH ENERGY. S. Kh. Biktimirov, Yu. P. Kumekin, S. B. Nurushev, and G. D. Stoletov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 25-30(Jan.-Feb. 1964). (In Russian)

Equipment for investigating polarization effects in proton scattering at high energies is described. The equipment consists of a mechanical device for arranging the targets and scintillation detectors in the proper geometry, equipment for the reliable detection of protons scattered on hydrogen targets, and analyzers to determine background radiation. (tr-auth)

20384 SPECTROMETER FOR FISSION NEUTRONS. M. V. Blinov and N. M. Kazarinov. Pribory i Tekhn. Eksperim., No. 1, 40-5(Jan.-Feb. 1964). (In Russian)

Apparatus for measuring the spectra of fission neutrons in the range 0.2 to 7 Mev by the time-of-flight method is described. Time intervals are measured by transforming them into pulse amplitude distributions which are registered in a multichannel analyzer. Time resolution, determined by the half width of γ-γ coincidences of ^{60}Co, is ~2 nsec for 100% efficiency and 0.7 nsec for 10% efficiency. Gas scintillation counters, semiconductor detectors, and ionization chambers serve as fission fragment detectors. The half width of time resolution for fission γ rays of these detectors are 3, 3 to 4, and 10 nsec, respectively. (tr-auth)

20385 APPROXIMATE METHOD FOR CALCULATIONS OF A MECHANICAL NEUTRON SELECTOR IN DIVERGENT BEAM GEOMETRY. V. Ya. Kitaev. Pribory i Tekhn. Eksperim., No. 1, 46-53(Jan.-Feb. 1964). (In Russian)

An approximate graphical method for calculating the properties of a mechanical chopper in neutron time-of-flight spectrometers that takes into account a divergent beam geometry is described. The method is illustrated by means of a specific example. Graphs of the geometrical functions, neutron pulses, and transmission functions are presented. The neutron transmission functions for divergent geometries are compared with previous methods for parallel beams. The method can be applied to calculations for multi-rotor phasing in neutron choppers. (tr-auth)

20386 USE OF INTEGRATED COINCIDENCE GAMMA SPECTROMETER FOR ANALYSIS OF COMPLEX DECAY SCHEME. B. P. Vikin and L. P. Perfilev (Voronezh State Univ., USSR). Pribory i Tekhn. Eksperim., No. 1, 53-6 (Jan.-Feb. 1964). (In Russian)

A method for observing the integrated coincidence spectra for low-lying levels of nuclei with complex decay schemes is described. For this purpose a β, γ, Σ_γ-coincidence spectrometer was constructed, where Σ_γ is the sum of the energy of two cascade gamma transitions, γ is one component of this sum, and β is part of the continuous beta spectra. The gamma cascade spectra of levels with Σ_γ ~1124 and 170 kev were obtained for mixtures of ^{152}Eu and ^{154}Eu. (tr-auth)

20387 ON THE ENERGY RESOLUTION IN A CASCADE GAMMA SPECTROMETER. E. M. Leikin (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 56-7(Jan.-Feb. 1964). (In Russian)

Expressions for the energy resolution of a scintillator-photomultiplier tube system in a gamma spectrometer are presented. (C.E.S.)

20388 THREE-ROTOR MECHANICAL NEUTRON CHOPPER. D. L. Broder, L. P. Khamyanov, V. S. Alnikov, and P. S. Klemyshev. Pribory i Tekhn. Eksperim., No. 1, 57-60(Jan.-Feb. 1964). (In Russian)

The design and basic characteristics of a three-rotor mechanical neutron chopper intended for time-of-flight measurements of radiative capture cross sections and γ rays from neutron capture in discrete resonance levels are presented. Rigid mechanical coupling by means of high precision gears provides the necessary synchronization of rotary motion and phase relation between the rotors of the chopper. The performance of the chopper is illustrated by a number of measurements with various time-of-flight methods. (tr-auth)

20389 BUBBLE CHAMBER IN A MAGNETIC FIELD. A. V. Bogomolov, Yu. A. Budagov, A. T. Vasilenko, et al. (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 61-8(Jan.-Feb. 1964). (In Russian)

A bubble chamber with a volume of $1 \times 0.5 \times 0.38$ m^3 intended for investigating synchrocyclotron beams with energies up to 10 Bev is described. The working fluid of the chamber is propane or a similar substance selected in conformity with the experimental problem. The chamber is located in a magnetic field of 17 kgauss. The precision for measuring particle momenta of ~5 Bev/c was determined to be ±3.2%. (tr-auth)

20390 USE OF HELIUM-3 FOR FILLING A HIGH-PRESSURE DIFFUSION CHAMBER. G. M. Aleksandrov, O. A. Zaimidoroga, M. M. Kulyukin, V. P. Peshkov, R. M. Sulyaev, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Shcherbakov (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 69-75(Jan.-Feb. 1964). (In Russian)

A method for obtaining liquid ^{3}He free from tritium ($T/^3He < 10^{-15}$) is discussed. A device with a high pressure diffusion chamber intended for use with a synchrocyclotron is described. The separate elements of the device are also described. (tr-auth)

20391 METHOD FOR MEASURING IONIZATION LOSSES OF RELATIVISTIC PARTICLES IN NUCLEAR EMULSIONS. E. G. Boos, N. P. Pavlova, O. I. Volkova, O. V. Gunenkova, K. G. Zaitsev, and A. V. Kholmetskaya (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Pribory i Tekhn. Eksperim., No. 1, 76-81(Jan.-Feb. 1964). (In Russian)

Variation in measurements using Ilford G-5 emulsions were found, and an attempt was made to eliminate them.

Subjective singularities and the effect of the incident angle on precise measurements were examined. It is shown that to achieve accurate measurements, ionization losses must be determined for tracks with incident angles up to 10°. (tr-auth)

20392 ON THE USE OF A PULSE IONIZATION CHAMBER FOR MEASURING THE ANGULAR AND ENERGY DISTRIBUTIONS OF FISSION FRAGMENTS. B. A. Bochagov and V. I. Fadeev (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 81-5(Jan.-Feb. 1964). (In Russian)

The possibility of using a pulse ionization chamber for simultaneously measuring the angular and energy distributions of fission products of heavy nuclei was investigated. A method for obtaining the angular distributions that completely eliminates the use of a collimator for determining directions is proposed. (tr-auth)

20393 RESOLVING POWER OF ARGON IONIZATION CHAMBER WITH WATER VAPOR MIXTURE. F. Nacyrov and V. A. Sokovishin. Pribory i Tekhn. Eksperim., No. 1, 85-7(Jan.-Feb. 1964). (In Russian)

The energy resolution of an ionization chamber filled with a mixture of argon and water vapor is investigated. For partial pressures of water vapor from 2.5 to 0.5 torr and an argon pressure of 2 atm satisfactory results are obtained. The pulse amplitude distribution of α particles from ^{238}Pu and ^{239}Pu with a halfwidth corresponding to 42 and 50 kev are illustrated. (tr-auth)

20394 EXTRAPOLATION IONIZATION CHAMBER FOR MEASUREMENTS WITH HIGH-ENERGY GAMMA RADIATION. S. P. Kruglov and I. V. Lopatin (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 88-90(Jan.-Feb. 1964). (In Russian)

An extrapolation chamber for measuring the ionization dependence on the width of the air gap is described. The working gap of the chamber can be varied from 45 to 1 mm, which permits extrapolation of the magnitude of specific ionization for null gap widths. The construction of the chamber makes it possible to measure the thickness of a material in front of the working gap. The chamber can be used for measuring transition curves and also energy-range curves for incident electrons and γ rays. (tr-auth)

20395 INVESTIGATION OF THE CHARACTERISTICS FOR DETERMINING THE ENERGY RESOLUTION OF SILICON n-p DETECTORS FOR NUCLEAR PARTICLES. N. B. Strokan (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 91-6(Jan.-Feb. 1964). (In Russian)

A method is proposed for measuring the effective time of collection and time of life of electron-hole pairs in a surface barrier radiation detector. It is shown that the energy resolution of the detector is proportional to the average loss of charge and quantities characterizing the nonuniformity of these losses. (tr-auth)

20396 MEASUREMENT OF MULTIPLE SCATTERING PARAMETERS BY TRACK PHOTOGRAPHS IN XENON CHAMBERS. I. A. Golutvin, V. D. Inkin, Yu. A. Karzhavin, E. I. Maltsev, V. D. Heustroev, V. D. Stepanov, and I. Chang (Joint Inst. of Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 97-100 (Jan.-Feb. 1964). (In Russian)

A device used for multiple scattering measurements on photographs from a xenon chamber is described. The device is built on the principle of a microscope and is provided with a spacing mechanism and a readout registration system with perforated tape. The apparatus accelerates data processing by 4 or 5 times. (tr-auth)

20397 COUNTING CHARACTERISTICS OF CO_2-DETECTORS. A. S. Karasik and A. I. Shafiev (Perm State Univ., USSR). Pribory i Tekhn. Eksperim., No. 1, 199-200(Jan.-Feb. 1964). (In Russian)

The performance characteristics of several $^{14}CO_2$-filled detectors are summarized. (C.E.S.)

20398 HIGH-EFFICIENCY HELIUM SCINTILLATION DETECTOR FOR DETECTING NEUTRONS. P. S. Ostavnov. Pribory i Tekhn. Eksperim., No. 1, 201 (Jan.-Feb. 1964). (In Russian)

Performance characteristics of a ^{4}He-filled scintillation detector for neutrons are discussed. Graphical illustrations of the counting rate vs gas pressure and a typical integrated neutron pulse spectrum are presented. (C.E.S.)

20399 EFFECTIVE LIGHT COLLECTION BY MEANS OF CONICAL LIGHT PIPES. A. G. Khabakhpashev and V. A. Tseluikin (Inst. of Nuclear Physics, Academy of Sciences, Siberian SSR). Pribory i Tekhn. Eksperim., No. 1, 202-3(Jan.-Feb. 1964). (In Russian)

The efficiency of conical light pipes for collecting and transmitting light between plastic scintillators and photomultiplier tubes was investigated. (C.E.S.)

20400 RECENT EXPERIMENTS WITH BUBBLE-CHAMBERS AT C.E.R.N. B. P. Gregory (Ecole Polytechnique, Paris). Proc. Roy. Soc. (London), Ser. A, 278: 331-40(Apr. 7, 1964).

Techniques associated with the use of bubble chambers at a high-energy proton synchrotron and some results obtained at CERN are discussed. Observations of ($\bar{p}$-p), (K^--p), and (π^--p) interactions and the resulting particles and resonances are discussed. (R.E.U.)

20401 RECENT EXPERIMENTS WITH COUNTERS AT THE C.E.R.N. PROTON SYNCHROTRON. J. M. Cassels (Univ. of Liverpool). Proc. Roy. Soc. (London), Ser. A, 278: 340-50(Apr. 7, 1964).

Some experiments at CERN involving p-p, π^--N, and π^+-p interactions are discussed. Data acquisition, by spark chamber photographs, and processing are discussed. (R.E.U.)

20402 DOSIMETRY OF ^{60}Co GAMMA RADIATION WITH FERROCENES IN CCl_4. E. Koerner von Gustorf, H. Kroenert, H. Koeller, G. Tillmanns, and G. O. Schenck (Max-Planck-Institut für Kohlenforschung, Abteilung Strahlenchemie, Mülheim-Ruhr, Ger.). Z. Naturforsch., 19b: 170-1(Feb. 1964). (In German)

Properties of ferrocene in carbon tetrachloride solutions for dosimetry of ^{60}Co gamma radiation are discussed. Dependence of yield of radiolysis products on dose and dose rate, on ferrocene concentration, and on temperature is shown in tables. (M.C.G.)

20403 DETECTION ATTEMPTS FOR ALPHA PARTICLES DURING IRRADIATION WITH THERMAL NEUTRONS ACCORDING TO THE REACTION $^{238}U(n,\alpha)^{235}Th$. I. Almodovar, I. Cantarell, and H. Bielen (Puerto Rico Nuclear Center, College Station, Mayaguez). Z. Physik, 177: 451-7(1964). (In German)

For the nuclear reaction $^{238}U(n,\alpha)^{235}Th$ no alpha particles were detected with an accuracy of ±0.05 per minute. The effective cross section for this reaction is smaller than 1×10^{-28} cm^2. An investigation was made using a highly sensitive and firmly assembled apparatus and, with its help, alpha particles that originated in this reaction could be detected. The apparatus contains the following elec-

tronic cells: A solid detector, a preintensifier–intensifier system with low noise level, and a 512-channel pulse height analyzer. (tr-auth)

20404 THE INFLUENCE OF A RADIAL THERMAL GRADIENT IN A GEIGER COUNTER. S. D. Chatterjee and R. C. Sastri (Jadavpur Univ., Calcutta). Z. Physik, 177: 562-5(1964). (In German)

It was found that a radial thermal gradient imposed on a Geiger counter modifies its operating parameters considerably, resulting in a bigger pulse-height, lower threshold potential, and smaller dead-time and rise-time. A close parallelism between the effects of a radial thermal gradient and a potential gradient was indicated. It is suggested that the alteration of the density of the enclosed gaseous mixture in the neighborhood of the axial wire is responsible for the corresponding modification of the Townsend avalanche region surrounding the wire. (auth)

20405 β SPECTROMETER WITH INTERMEDIATE IMAGE. Yueh-shua Chou, Pei-kung Wung, and Lin-cheng Ching. Wu Li Hsueh Pao, 17: 255-62(June 1961). (In Chinese)

A beta spectrometer with an intermediate image is described. It is a type of longitudal magnetic spectrometer. It has a better magnetic field distribution than conventional double lens spectrometers. For this reason it has a higher luminosity for the same resolution power. The characteristics of the apparatus are given. For a source with a diameter of 1 mm the resolution is ~1.5% and luminosity is ~2.5%. The apparatus is used for investigating β and γ spectra of radioisotopes. The energy range for measuring electrons extends from several kev to 2.5 Mev. (tr-auth)

20406 COUNTERS WITH CONTROLED PULSE SUPPLY. [PART] I. Hsiao-wei Tang. Wu Li Hsueh Pao, 17: 273-86(June 1961). (In Chinese)

A summary of a systematic investigation of counters with a controlled pulse supply is presented. The characteristics of conventional self-quenched counters, low-voltage halogen counters, and non-self-quenching counters are discussed. By means of a controlled pulse supply, new hodoscopic systems were developed. The mechanisms and characteristics of these new detectors are discussed. (tr-auth)

20407 THE WAVE OPTICS INTENSITY DISTRIBUTION IN THE LINE FOCUS OF SPECTROMETERS FOR CHARGED PARTICLES. F. Lenz and E. Krimmel (Universität, Tübingen, Ger.). Z. Physik, 176: 191-6(1963). (In German)

The intensity distribution in the line focus of first-order focusing spectrometers for charged particles was calculated, taking into account the interference effects in the coherently irradiated vicinity of the line focus and the diffraction by a narrow aperture defining slit. The gradual transition of this intensity distribution from that with no aperture limitation to that of a very narrow slit is shown. (auth)

20408 SCINTILLATION LIGHT YIELDS OF ORGANIC MOLECULAR CRYSTALS FOR ALPHA PARTICLES AND ELECTRONS. M. Schumacher and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik, 178: 11-18(1964). (In German)

Accurate pulse-height ratios for α-particle and electron excitations were determined for single crystals of anthracene, naphthalene, terphenyl, diphenyl, diphenylene oxide, fluorene, stilbene, and plastic scintillator. The α/β-ratios were strongly dependent on the impact direction of the α particles with respect to the crystal axes because of the anisotropic light yield for α particles. (auth)

20409 THE THICKNESS-DEPENDENT ROTATION OF THE LIGHT-YIELD CHARACTERISTICS OF ANTHRACENE AND p-TERPHENYL CRYSTALS IN THE CASE OF IMPACT OF ALPHA PARTICLES. Ernst Berkhan (Universität, Göttingen, Ger.). Z. Physik, 178: 101-8(1964). (In German)

Thick single crystals of anthracene and p-terphenyl had a maximum of their scintillation yield with the impact direction of the α particle perpendicular to a cleavage plane. For thin crystals the direction of maximum light output showed a deviation, γ, up to 20° depending exponentially on the crystal thickness. Blackening the backside of the crystals decreased γ. The existence of far-reaching excitons in the b,c-plane gave a rough picture of these phenomena. A minimum of the scintillation yield of p-terphenyl crystals was measured at a temperature of –90°C. Below –90°C the scintillation light showed a new decay component with a period of 2 μsec. (auth)

20410 USE OF SOLID-STATE DETECTORS AS ENERGY SPECTROMETERS FOR COSMIC HIGH-ENERGY PARTICLES. J. Labeyrie (CEN, Saclay, France). p.187-93 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Advantages of semiconductor- over gas-filled ionization chambers are enumerated. Measurements of proton and pion energy deposition at 0.5 to 1.5 Bev obtained with silicon filled detectors are given. (M.J.T.)

20411 γ-SPECTROGRAPHY IN A ROCKET. J. Goupil (CEN, Saclay, France). p.211-19 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

A scintillation counter and telemetry device for measuring and transmitting the 0.1 to 2 Mev gamma spectrum at the top of the atmosphere is described. (M.J.T.)

20412 SPACECRAFT INFORMATION SYSTEMS. G. H. Ludwig (Goddard Space Flight Center, Greenbelt, Md.). p.348-85 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The basic experimental system and basic circuits and their laws are described. Systems of signal conditioning, data handling, telemetry, encoding and detection, data recovery, and data reduction for experiments in space are discussed. (M.J.T.)

20413 RADIATION-INDUCED SIGNALS IN SEMICONDUCTOR DEVICES. George Arthur Gilmour. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 95p.

Theoretical and experimental results for the signal induced in semiconductor devices by fast neutron radiation are presented and compared with the signal induced by γ rays. It is shown that a fission source should give a ratio of γ-ray-induced signal to neutron-induced signal of ~15 for Si devices and ~500 for Ge devices. Collision theory is used to determine the energy spectrum of "knocked-on" semiconductor atoms in a known fast-neutron flux. The current signal for a given radiation flux is determined by integration of the ion pairs produced. Experimental verification of the theory was obtained using the Cornell TRIGA reactor as the source of neutrons. The γ flux was depressed by use of Pb shielding in order to make the neutron measurements. Boral (boron carbide in Al) was used to eliminate thermal neutrons, which would result in capture γ rays. The γ rays resulting from inelastic scattering of fast neutrons in Pb were analyzed. Both d-c and pulse techniques were used to investigate the signals induced in Si rectifiers. The fast-neutron-flux spectrum inside the Pb shielding was estimated by a modified Fermi Age theory and calibrated by use of a new type of absolute fast-neutron-flux detector. This detector, which uses phosphorus for internal calibration of a sul-

fur threshold detector, is described. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20414 STUDIES OF THE PRODUCTION OF NUCLEAR EMULSIONS. G. Heimann. Thesis, Berlin, Universität, 1960. 65p. $2.00(Gmelin, AED-DISS. 60-10). (In German)

A method for the production of nuclear emulsions is given. Silver halides are precipitated in diluted solutions. Methods for sensibilization are discussed. Sensitivities for 3 types of emulsions for fission products, alpha particles, and electrons are given. (Gmelin Inst.)

20415 COUNTER MODELS AND APPLICATIONS TO DETECTION PROBLEMS. Hans Jacob Zweig. Thesis, Stanford, Calif., Stanford Univ., 1963. 80p.

Some of the machinery of statistical estimation theory is applied to the study of radiation detectors. Probabilistic models are devised that simulate a radiation detector. Given the output from the simulated detector, methods for estimating the parameters under consideration are studied. A measure of the performance or efficiency of a simulated detector is devised, and several possible detectors are evaluated and compared with respect to it. These include the classical type I and type II counters as well as a new counter model called the coincidence counter. (Dissertation Abstr., 24: No. 8, Feb.(1964))

20416 COLLIMATORS FOR RADIOISOTOPE SCANNING SYSTEMS. Robert N. Beck (Univ. of Chicago). 23p. (CONF-453-4)

From IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964.

The successful use of scanning systems in diagnostic procedures depends upon the preferential uptake of the administered isotope in certain tissues and the detailed mapping of the distribution of radioactivity by means of a collimated γ-ray detector. The sensitivity and field of view of the collimated detector affect the success of the technique. The design, construction, and testing of single and multichannel collimators for use with scanning systems are discussed. (C.H.)

20417 SEMICONDUCTOR RADIATION DETECTOR. Donald J. Shombert (to Merck and Co., Inc.). U. S. Patent 3,131,305. Apr. 28, 1964. Filed May 12, 1961.

A semiconductor radiation detector structure for counting high-energy particles is described in which a relatively low applied bias and resistivity are utilized. The structure comprises a plurality of contiguous layers of semiconductor material of alternating conductivity type, thereby forming a plurality of junctions, with the diffusion length of minority carriers in each layer being small relative to the layer thickness. Means is provided for biasing alternate junctions in a reverse direction to form a wide depletion region. A resistivity of 40 or 100 ohm-cm and a bias voltage of 3000 volts (200 volts for each individual junction) are typically used. The preparation of the structure by vapor deposition is described. (D.L.C.)

ISOTOPE TECHNOLOGY

Industrial Applications

Refer also to abstracts 20048, 20120, and 20253.

20418 EFFECTS OF SMALL-DOSE γ IRRADIATION ON COTTON SEEDLINGS. N. N. Nazarov (Inst. of Genetics and Physiology of Plants, Tashkent). Agrobiologiya, No. 4, 541-7(1963). (In Russian)

It is shown that irradiation with small γ doses (from 0.2 to 5 kr) depressed cotton plant wilt resistance, especially in the 108F type plants. The effect extended to a certain degree to the second harvest. Irradiation of dampened seedlings with 5-kr doses had no effect during the first spring chilling, but strongly depressed the resistance of the second and third generation plants to pathogenic microorganisms in cold soil. Moreover, survival and growth were depressed. Irradiations (5 kr) that produced no changes in the first and second harvest resulted in changes in the third harvest. (R.V.J.)

20419 COBALT-60 GAMMA-RAY IRRADIATOR. R. J. Romani, E. C. Maxie, C. O. Hesse, and N. F. Sommer (Univ. of California, Davis). Calif. Agr., 16: 1-4(Mar. 1962).

A description and illustrations are provided for the installation, specifications, safety features, and applications of the new ^{60}Co unit to be used for investigation of radiosterilization of fruit. Maximum safety and simplicity of operation are inherent in the design of the unit, the irradiation housing of which consists of an underground stainless steel tank 6 ft in dia and 11 ft deep. An 18-ft elevator and guide system, three watertight irradiation chambers, and 32,500 C of ^{60}Co are mounted within the tank. The radiocobalt is enclosed in 140 tubes, each consisting of an inner and outer envelope that is individually sealed. The tubes are arranged in two 19- × 23½-in. plaques permanently positioned opposite each other in vertical, parallel planes at the bottom of the tank. Lowering the irradiation chambers is accomplished by three 18-ft stainless steel worm screws, which are electrically driven and may be actuated manually or set to automatically lower and then raise the chambers after a prescribed irradiation time. Among the safety and warning devices are two radiation monitors and a water level probe. These monitors actuate both audible and visual alarms should malfunctions arise. An important design feature for biological experimentation is the relatively large and uniform dose field. The three irradiation chambers used measure 6 × 14 × 20 in. each. The center chamber receives a uniform irradiation throughout most of its volume and the outer chambers can be assured of uniform dose distribution by raising them at half irradiation time and turning the contents 180°. Another important feature is the ability to introduce air or other atmospheric mixture into the chambers during the irradiation period, which is accomplished by attaching polyethylene tubing to the inlet and outlet ports on the lid of each chamber and pumping through the desired air mixture. A coil of tubing around the inner perimeter of the center chamber acts as a heat exchanger, by which it is possible to irradiate at any temperature in a range from below freezing to about 150°F. Planned experiments for the fruit research program include a survey of many varieties of fruit which could benefit from an extended storage life. (BBB)

20420 RADIOISOTOPES IN SEMICONDUCTOR SCIENCE AND TECHNOLOGY. PART 2. Werner Kern (Radio Corp. of America, Somerville, N. J.). Semicond. Prod., 6: No. 11, 23-7(Nov. 1963).

Absorption and desorption phenomena were studied and the results were applied to the development of methods for removing contaminants from solutions and surfaces. Materials and devices were processed by standard methods, but the various reagents were labeled by the addition of radioisotopes. Contamination of semiconductor crystals by crucible impurities was also studied. Synthesis of gallium arsenide in radioactivated quartz boats and subsequent analysis of the emitted nuclear radiation from the crystal samples was chosen as the analytical basis because of the inherent sensitivities of the method for trace quantities. The experiments were designed primarily to obtain information on the extent and mechanism of silicon contamination; other impurities originating from the quartz were identified as a secondary objective. It was found that high-purity synthetic quartz produced much lower non-silicon contamination levels than natural quartz. Data are tabulated. (P.C.H.)

20421 PRODUCTION OF RADIOACTIVE COBALT-60 SOURCES. I. SOURCES FOR GAMMA-RADIOGRAPHY. D. Nemoda (Inst. of Nuclear Science "Boris Kidric," Belgrade). Tehnika (Belgrade), 18: 229-33(Feb. 1963). (In Serbo-Croatian)

The advantages and specific properties of ^{60}Co sources used in industrial radiography, medical teletherapy, and material radiation are described. Production methods for radiographic sources of ^{60}Co, ^{192}Ir, ^{182}Ta, and ^{137}Cs are given. The decomposition scheme for ^{60}Co and ^{192}Ir isotopes is shown. Various aspects of the radiation and activity in a reactor are covered, with particular reference to the thermal neutron flux. The protection of the sources enclosed in special pure Al carriers, as well as the role of the filtration of softer radiation sources components are given special attention. The problem of re-activity is treated in the description of some aspects of production and use of radiographic sources. (auth)

20422 SEVERAL METHODS FOR PREPARING RADIOACTIVE STANDARDS FOR ALPHA AND BETA URANIUM SOURCES. Dorde Nemoda (Inst. for Nuclear Science "Boris Kidric," Belgrade). Tehnika (Belgrade), 18: 429-33(Mar. 1963). (In Serbo-Croatian)

Electrolytic methods for obtaining U radiation sources are described. The radiochemical and electrochemical characteristics of U are described which permit the preparation of a thin or a thick oxide saturation layer on the cathode. Experiments are described representing the deposit of U on metallic surfaces by acido-sulfuric solutions with adapted acidity. The influence of acidity, temperature, concentration, reaction period, and surface size was studied. Under the optimal $(NH_4)_2CO_3$ acidity, Fe, Al, and Cu are receptive in that order. (OID)

20423 ISOTOPES, RAYONNEMENTS, AGRICULTURE. Bulletin Bibliographique Mensuel, Vol. 2. (Isotopes, Radiation, Agriculture. Bibliographic Bulletin, Vol. 2). Cadarache, France, Centre d'Etudes Nucléaires, 1964. 47p.

References (110) to literature (1963) on nuclear techniques in agriculture are presented. Tracer studies and techniques, radiation effects and uses, element and isotope uptake, neutron soil moisture probes, and soil contamination are covered. Author, document, and subject indexes are included. (D.C.W.)

20424 ISSLEDOVANIE VOZMOZHNOSTEI PRIMENENIYA RADIOAKTIVNOGO IZLUCHENIYA PRI NORMALIZATSII PROTSESSA TKACHESTVA. (Investigation of the Feasibility of Utilizing Radioisotopes in Wearing Process). P. V. Vlasov. Moscow, Gizlegprom, 1963. 151p.

Applications of radioisotopes in studying textile structure and wearing are described. The methods, equipment, and techniques used in experimental studies are discussed. (R.V.J.)

20425 NUCLEAR TECHNIQUES FOR PRODUCT IMPROVEMENT. Harvey A. Burley (General Motors Corp., Detroit). New York, Society of Automotive Engineers, 1964, Preprint 828A, 8p. (CONF-464-1)

From Society of Automotive Engineers Meeting, Detroit, Mar.-Apr. 1964.

The versatility of radioisotopes in modern industry is illustrated by means of a number of recent applications. Thickness, density, and moisture gages are described. A new radiography source, ytterbium-169, is shown to be valuable for radiographing thin sections of steel and aluminum. Also covered are the measurement of silicon content of iron by activation analysis, and the use of radioactive tracers to detect headlamp leakage rates, damping fluid penetration in gyros, and grease content of pregreased automotive parts. (auth)

20426 STUDY OF THE RADIOMETRIC METHOD AND USE OF THE LIQUID SCINTILLATION TECHNIQUE FOR TOOL-WEAR DETERMINATION. G. F. Wilson and W. Dennis McHenry (Rock Island Arsenal, Rock Island, Ill.). New York, American Society of Mechanical Engineers, 1964, Preprint Paper 64-Prod-7, 6 p. (CONF-463-1)

From American Society of Mechanical Engineers Production Engineering and ASTME Conference and Exposition, Detroit, Apr. 1964.

A radiometric method of tool-wear evaluation was investigated and evaluated by comparing the results with those obtained from visual wear measurements. A liquid scintillation technique is presented for accurately determining tool wear for cutting times as low as 0.003 min. It is recommended that the radioactive tracer techniques of measuring tool wear be used as supplemental methods in conjunction with visual wear determination procedures rather than primary methods of evaluating machining variables. (auth)

20427 METHOD OF USING RADIOACTIVE TRACERS. Alan Beerbower and John L. Murray (to Esso Research and Engineering Co.). U. S. Patent 3,130,314. Apr. 21, 1964. Filed Nov. 23, 1959.

An improved method of using short-lived tracers in studying mixing, fluid flow, leaks, etc., in the processing of petroleum hydrocarbons, is described in which the time required to prepare the tracer for injection is shortened. This method involves the admixing of a surface-active solubilizing agent with an aqueous solution of the tracer, addition of a small amount of hydrocarbon, and injection into the system to be studied. Examples of the solubilizing agent are sodium mahogany sulfonates, fatty alcohol sodium sulfates, sorbitol oleates, metallic naphthenates, etc. Two examples of the method are given in which ^{24}Na and ^{132}I were used. (D.L.C.)

Power Application

Refer also to abstracts 20874, 20876, 20877, 20878, 20882, 20883, and 20885.

20428 USE OF RADIOISOTOPES AS SOURCES OF ENERGY. Miguel Bernat. Ciencia Tec. (Buenos Aires), 132: 358-74(Nov.-Dec. 1963). (In Spanish)

The uses of radioisotopes in power systems are described. The activation process, radioactive decay, and power change with time are discussed. Methods of obtaining radioisotopes are outlined. Different radioisotope power systems and their uses are described, with regard to their specific problems and to the systems employed for direct heat to electric power conversion. (auth)

Separation and Production

20429 (HW-71793) ESTIMATED COSTS FOR THE PRODUCTION OF PURE MERCUTY-204 ISOTOPES. C. A. Rohrmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 1, 1961. Contract AT(45-1)-1350. 11p.

Using the limited technical data available on the monoisotopic photochemical mercury isotope separation process, a very preliminary estimate was made for the cost of producing about 2500 kilograms of pure mercury-204 per year. This cost was calculated to be $47.50 per pound of mercury-204. Thin result appears to be sufficiently low to encourage further studies on its use. About 70% of this cost is for management, labor, inventory, and capital charges. The cost of raw material (mercury), process chemicals, yield losses, and utilities (electricity) comprises the remaining 30% of the total production cost. Important cost reductions can be visualized only by research and development which will increase substantially the capacity of the process equipment which then will reduce the major cost elements—management, labor, inventory and capital charges. Although cost reductions in chemicals and utilities may also be achievable, such reductions will not result in major reductions in total production cost, since these elements comprise the smaller fraction of the estimated total costs. (auth)

20430 SPECTRAL ISOTOPIC ANALYSIS OF LEAD FROM POLISH GALENA DEPOSITS. Lubomir Gabla, Jozef Mokwa, and Henryk Niewodniczanski (Inst. of Physics, Krakow). Acta Geophys. Polon., 11: 147-51(1963). (In Polish)

The optical isotopic analysis, based on the isotope shift effect, is briefly described. This method was applied to the percentage measurement of ^{206}Pb, ^{207}Pb, and ^{208}Pb isotopes content in natural lead, originating from two different ores. The results of the measurements are given. (auth)

20431 THE PRODUCTION AND USE OF TRITIUM. Zoran Makaimović and Tatjana Ceranić (Inst. for Nuclear Science "Boris Kidric," Belgrade). Tehnika (Belgrade), 18: 434-40(Mar. 1963). (In Serbo-Croatian)

The preparation of tritium from the irradiation treatment of various ^{6}Li alloys (chiefly, Mg–Li and Al–Li) is described. Equipment used for extracting the tritium from the irradiated alloy and the subsequent purification are

described. The technique is discussed for preparing tritium targets, as a material for nuclear and thermonuclear reactions, as a source of ionized radiation, and as an indicator for chemical, biochemical and medical processes. Difficulties experienced with its soft β radiation and methods used most often in measurement and detection are reviewed. (OID)

20432 ELECTROMAGNETIC SEPARATION OF OSMIUM ISOTOPES. V. S. Zolotarev and V. M. Gusev. Pribory i Tekhn. Eksperim., No. 1, 141-2(Jan.-Feb. 1964). (In Russian)

The performance of an electromagnetic separator for osmium isotopes is described. The instrument has ~180° ion focusing and an ion trajectory radius of 900 mm. The ions are produced from OsO_4 vapor. Experimental results are discussed. (C.E.S.)

20433 THE SEPARATIVE POWER OF SHORT COUNTERCURRENT COLUMNS. J. Los (Laboratory of Mass Separation, Amsterdam). Z. Naturforsch., 19a: 106-10 (Jan. 1964).

For separating isotopes on a large scale, the separative power of a unit is its most important feature. For a countercurrent device it is commonly assumed that its separative power is a maximum throughout the column. A detailed treatment of the equation of a square cascade, which is formally equal to the column equation, shows that it depends on the way the square cascade is operated. In most cases the column is operated as a closed unit, under which circumstances the separative power is reduced to 80% of its maximum value. (auth)

20434 THE CONCENTRATION DEPENDENCE OF THE SEPARATION FACTOR OF THE LITHIUM ISOTOPES IN ION EXCHANGE. G. Dickel and K. Richter (Universität, Munich). Z. Naturforsch., 19a: 111-14(Jan. 1964). (In German)

It was found that the separation factor for the lithium isotopes in a system of polystyrene exchange solution passes through a maximum. This effect can be explained if it is assumed that the curves of the logarithmic activity coefficients of the two isotopes are distinguishable. (tr-auth)

20435 INVERSION TEMPERATURE IN THE SEPARATION OF ISOBARIC CO MOLECULES BY THERMAL DIFFUSION. A. E. de Vries and A. Haring (F.O.M. Laboratorium voor Massascheiding, Amsterdam). Z. Naturforsch., 19a: 225-30(Feb. 1964). (In German)

In specially constructed thermal diffusion columns, separations between the isotopic mixtures $^{12}C^{18}O/^{12}C^{16}O$ and $^{14}C^{16}O/^{12}C^{16}O$ were measured at average temperatures ranging from 260 to 465°K. At temperatures above 320°K $^{14}C^{16}O$ concentrated more strongly in the cold region than $^{12}C^{18}O$. Below this temperature the opposite effect took place: the thermal diffusion factor $\alpha(^{12}C^{18}O/^{12}C^{16}O)$ was greater than $\alpha'(^{14}C^{16}O/^{12}C^{16}O)$. All separations were carried out at temperatures for which the heavier molecule was concentrated in the cold region. (auth)

20436 IMPROVEMENTS IN METHODS OF PRODUCING IODINE-131. Michel Douis and Umberto Rosa (to Commissariat à l'Energie Atomique). British Patent 955,394. Apr. 15, 1964. Priority date Apr. 15, 1960, France.

A method is given for the production of pure ^{131}I with a high yield and activity by the neutron irradiation of tellurium compounds. In the method, tellurium dioxide is first irradiated and then dissolved in an alkaline solution to form tellurite, the tellurite is oxidized by H_2O_2 to form tellurate, the solution is acidified, and ^{131}I is distilled from the solution. An apparatus for carrying out the dissolution, oxidation, and distillation is described. (D.L.C.)

20437 METHOD OF MANUFACTURING POROUS BARRIERS. Micheline Calis, Jean Edouard Charpin, and Pierre Plurien (Commissariat à l'Energie Atomique). U. S. Patent 3,131,239. Apr. 28, 1964. Priority date Apr. 26, 1957, France.

A method is described for making porous barriers having a very great number of very small pores, for isotopic separation of gases. The method comprises mixing with a thixotropic organic binder a powder of a metal oxide and/or metal with the grain size of the powder being about twice that of the desired pores, shaping the paste, sintering the shaped paste under such conditions that the welding together of the grains is just started, and quickly cooling the sintered product. The sintering conditions must be carefully controlled so that no pores are enlarged or clogged; for alumina, the sintering should be conducted at 1100 to 1300°C, as compared to temperatures of 1800°C for the sintering of gastight products. Three examples of the method are described in which alumina, titania, and magnesia barriers were made. (D.L.C.)

MATHEMATICS AND COMPUTERS

20438 (CERN-561 and Apps.) REPORT OF THE EUROPEAN COMMITTEE ON THE FUTURE COMPUTING NEEDS OF CERN. (European Organization for Nuclear Research, Geneva). Oct. 25, 1963. 173p.

Includes Appendices I through VIII.

CERN's computer needs (discussed) were determined, and offers of computer systems to meet these needs were solicited from American and European manufacturers. On the basis of a comparative study of the machines offered, it was recommended that a CDC 6600 be installed early in 1965. The technical and economic considerations on which the recommendation is based are summarized. (D.C.W.)

20439 (NAA-SR-Memo-9683) FIRED—(INTEGER DATA RELATIVE READ). R. J. Mikell and G. T. Chang (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 24, 1964. Contract AT (11-1)-Gen-8. 5p.

FIRED is a subroutine similar to FORED. This routine provides the facility for reading integer data into a specified element of an array. These elements may be in sequential or in nonconsecutive locations. FIRED was found necessary during development of routine necessary for FSM-1 data reduction programming. (auth)

20440 (WAPD-T-1576(Rev.)) ON THE BEST METHOD FOR CHOOSING THE WEIGHTING FUNCTIONS IN THE METHOD OF WEIGHTED RESIDUALS. S. Kaplan (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Jan. 1963. Contract [AT(11-1)-Gen-14]. 18p.

A rule for selecting the weighting functions in the weighted residual method for obtaining approximate solutions to various types of equations and boundary value problems is derived. (D.C.W.)

20441 DEVELOPMENT OF SINGULARITIES OF SOLUTIONS OF NONLINEAR HYPERBOLIC PARTIAL DIFFERENTIAL EQUATIONS. Peter D. Lax (New York Univ., New York). J. Math. Phys. (N. Y.), 5: 611-13(May 1964).

In a recent paper Zabusky gave an accurate estimate of the time interval in which solutions of the nonlinear string equation $y_{tt} = c^2(1 + \epsilon y_x)y_{xx}$ exist. A previous numerical study of solutions of this equation disclosed an anomaly in the partition of energy among the various modes; Zabusky's estimate shows that when the anomaly is observed the solution does not exist. The proof of Zabusky uses the hodograph method; here a much simpler derivation of the same result based on an estimate given some years ago by the author is given. (auth)

20442 DIFFUSIONS AND POISSON COLLECTIONS. Gordon Bradley Crawford. Thesis, Princeton, N. J., Princeton Univ., 1962. 48p.

If $\{X_i(t),\ 0 \le t < \infty\}_{i=0}^{\infty}$ is a sequence of independent stochastic processes from a probability space (Ω,α,P) to a σ-finite measure space (χ,β,μ), then $\{X_i(t)\}$ is said to be a Poisson collection whenever the number of coordinates in a fixed set $B \epsilon \beta$ is a Poisson random variable with mean $\mu[B]$. Such a random collection taking values in a given measure space is constructed, and applications of a Poisson collection are given. It is shown that if $\{X_i(0)\}$ is a Poisson collection then $\{X_i(t)\}$ is also, and the number of absorptions in an absorbing barrier is a Poisson random variable. In the case of a diffusion on the real line, a Poisson collection is considered with respect to the speed measure and it is shown that the number of absorptions is a.s. finite (or equivalently, has a finite mean). A diffusion with constantly changing mass whose associated semigroup has generator Ω: $\int \Omega f dm = \int df' + \int f d\gamma$ where γ is a signed measure is described. For this case the distribution of mass at time t, and the distribution of the mass absorbed by an absorbing barrier was found, both for a single particle and a Poisson collection. A sequence of dependent diffusions, whose initial distribution is a Poisson collection with respect to Lebesque measure, is also considered. The individual sample paths are that of Brownian motion, but the sequence has the additional property that particles coalesce upon contact. Several distribution problems for this process were solved, and a two particle system with an attracting force is described. (Dissertation Abstr., 24: No. 9, March 1964).

METALS, CERAMICS, AND OTHER MATERIALS

General

20443 (AD-416199) FURTHER DEVELOPMENT OF A DUCTILE TUNGSTEN-BASE SHEET ALLOY. Quarterly Progress Report No. 2, May 8–August 8, 1963. J. L. Ratliff, D. J. Maykuth, H. R. Ogden, and R. I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Aug. 30, 1963. Contract N600(19)-59738. 28p. (N63-20620)

Two groups of alkali-silicate-doped tungsten alloys were prepared to screen the effects of doping additions and processing conditions on the structure of otherwise unalloyed tungsten. Alloy compositions for the two groups of materials included unalloyed controls and both experimentally and commercially doped (type-218) alloys. From the results of evaluations conducted on these materials, the type 218 powder was selected as the base material for the subsequent development of W-5Re-(ThO_2/ZrO_2) alloys. (auth)

20444 (AD-417111) LIQUID METALS, LIQUID METAL ALLOYS AND THEIR APPLICATIONS. A Report Bibliography. Angelo Muccino, comp. (Defense Documentation Center, Arlington, Va.). Sept. 1963. 72p.

A selected list of references in abstracted form is presented which includes documents cataloged by the Defense Documentation Center from 1953 through July 1963. The liquid metals considered are these melting between –38 and 420°C and which are used as heat exchangers. The references are arranged into the following subject areas: coolants and cooling, corrosion, electrochemistry, fluid mechanics, heat exchangers, heat transfer, lubricants and lubrication, power, properties, seals, thermodynamics, and miscellaneous. (D.L.C.)

20445 (AD-434441) STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS. Fourth Bimonthly Progress Report, January 1 to February 29, 1964. (Metals and Controls Inc., Attleboro, Mass.). Mar. 31, 1964. Contract NOw-63-0706-c. 38p.

Oxidation loss rates for platinum and platinum–10% rhodium alloy samples were determined to be 1.98 and 2.40 microinches per hour, respectively, at 2550°F in an air flow of 480 ipm. From extrapolation it was found that in the absence of interdiffusion of coating and base metal, 2.5 mils of platinum would protect the base metal for 100 hours at 3000°F in an air flow of 480 ipm. An increase in dew point from about –40 to 120°F for the air used in testing was seen to have an insignificant effect on the oxidation rate of pure platinum at 2200 and 2550°F in an air flow of 24 ipm. Tests showed coated TZM and FS-85 to be attacked differently. Molybdenum from the TZM was found to diffuse through the coating and be removed at its surface as a volatile oxide. Oxygen penetrated the coatings on the FS-85 samples in a discontinuous manner, causing blisters of oxide to be formed which eventually burst through the coating. An attempt was made to prepare a platinum–10% rhodium clad FS-85 sample with an intermediate rhenium diffusion barrier layer. The components of the proposed composite were hot roll bonded in an evacuated package. However, the rhenium layer broke up during rolling and the composite was not suitable for testing. Other methods for preparation of this type of composite, such as electrolytic and vapor plating, are being considered. Samples of platinum coated FS-85 and TZM with boron nitride as a diffusion barrier were prepared through chemical vapor deposition and hot press bonding techniques. Edge protection proved to be a problem in tests on these samples, as they always failed at the edges where no boron nitride had been deposited. Also, in hot press bonding platinum to the composite, the edges of the platinum were subjected to a shearing action which probably caused it to be much thinner there. (auth)

20446 (ASD-TDR-63-766) DEVELOPMENT OF HIGH-STRENGTH, ELEVATED-TEMPERATURE, CORROSION-RESISTANT STEEL. A. Kasak, V. K. Chandhok, J. H. Moll, and E. J. Dulis (Crucible Steel Co. of America, Pittsburgh). July 1963. Contract AF33(657)-8458. 115p. (AD-425593)

The development of the new high-strength hardenable stainless and elevated-temperature steel—AFC-77—was continued. The complex precipitation reactions in the Cr–Mo–Co steels were studied. Strengthening after tempering at temperatures up to 900°F is related to the precipitation of carbides. Above 1000°F, the Fe_2Mo and chi phases are the primary strengthening agents. A production heat of AFC-77 was processed to bar, billet, and sheet materials. The important mechanical properties and microstructural characteristics of the mill-produced materials were evaluated and found to be satisfactory. Samples of these materials have been made available to qualified potential users for evaluation and experimental application. (auth)

20447 (ASD-TR-7-797(IX)) TUNGSTEN FORGING DEVELOPMENT PROGRAM. Ninth Interim Technical Progress Report, May 19, 1963–August 19, 1963. E. J. Breznyak (Thompson Ramo Wooldridge Inc., Cleveland). Contract AF33(600)-41629. 47p. (AD-419855; ER-5498)

The process developed for the thin section W–2% Mo forging was successfully scaled up. Initial forging trials of the scaled up configuration were completed with high purity cast extruded unalloyed tungsten billets having hot-cold worked and recrystallized structures. Test data indicate the superiority of starting billets of uniformly recrystallized structures. Evaluation of forgings produced demonstrates that forging quality can be controlled during scale up. Ductile-brittle transition temperature and high temperature tensile properties are reported. (auth)

20448 (BM-RI-6436) DIRECT ELECTROLYSIS OF URANIUM DIOXIDE TO URANIUM METAL IN FLUORIDE MELTS. Donald G. Kesterke, D. C. Fleck, and T. A. Henrie (Bureau of Mines. Reno Metallurgy Research Center, Nev.). Oct. 1963. 15p.

Uranium metal was electrowon from uranium dioxide dissolved in fluoride melts. The UO_2 was fed directly to the cell in a continuous manner. Electrolysis was performed at 1200 to 1300°C in electrolytes composed of UF_4, LiF, and BaF_2. A single regulus of metal was collected in a confined area of the crucible. Product purity of 99.8 percent was attained. Carbon was the major contaminant. Compartmented cells were studied as a means of confining the oxide feed to the vicinity of the anodes. (auth)

20449 (BMI-973(Del.)) THE PROPERTIES AND HEAT TREATMENT OF ZIRCONIUM–URANIUM ALLOYS. W. Chubb, G. T. Muehlenkamp, and G. K. Manning (Battelle Memorial Inst., Columbus, Ohio). Jan. 10, 1955. Contracts W-7405-eng-92 and NObs-65057. 50p.

The heat treatment and mechanical properties of four zirconium–uranium alloys ranging in composition from 10 to 41 wt % uranium were investigated. Tensile, hardness, Jominy end-quench, and metallographic data constitute the basis for much of the report. Other data reported include the results of high-temperature creep, tensile, hardness, cold rolling, thermal-cycling, and dynamic-modulus tests. An attempt is made to show that the behavior of the alloys investigated can be generalized and extended to include all alloys in the zirconium-uranium system containing up to 47 wt % uranium. (auth)

20450 (BMI-1661(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING JANUARY 1964. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). Feb. 1, 1964. Contract W-7405-eng-92. 65p.

Progress is reported in programs relating to reactor materials and components, fuels, radioisotope and radiation applications, a tracer system for in-place filter evaluation, coated-particle fuel materials, corrosion in the fluoride volatility process, creep-rupture of SAP alloys, mechanical properties of Zr alloys, fission product deposition, UO_2–ZrO_2, encapsulation, and joining of regenerative cell components. (D.L.C.)

20451 (CEA-2390) PREPARATION DE COUCHES MINCES DE CARBONE. (Preparation of Thin Carbon Films). M. Gillois (France. Commissariat a l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 20p.

Carbon deposits have been prepared on silica glass supports in order to determine more accurately than by weighing the losses liable to occur during oxidation, for example under irradiation in the presence of CO_2. Several processes have been studied with a view to obtaining deposits for which the variation in optical density as a function of carbon departure shall be reproducible for each sample. Among the methods used, the most satisfactory is that in which the pyrolitic carbon deposited on a carbon filament is evaporated; however only the samples prepared simultaneously exhibit the required identical behavior. The carbonaceous deposits have been studied by micro-electronic diffraction. An examination of the photographs shows the presence of graphite monocrystals of about $(30\ \mu)^2$. (auth)

20452 (DMIC-195) PROPERTIES OF COATED REFRACTORY METALS. W. A. Gibeaut and E. S. Bartlett (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Jan. 10, 1964. Contract AF 33(615)-1121. 95p. (AD-433782)

A review is presented of the information generated since the middle of 1961 on the chemical, physical, and mechanical properties of refractory metals that are coated with oxidation-resistant coatings of advanced-experimental or commercial status. It is a supplement to DMIC Report 162, "Coatings for the Protection of Refractory Metals from Oxidation," dated November 24, 1961. Recent data on specific silicide- and aluminide-type coatings for niobium, molybdenum, tantalum, and tungsten and their alloys reflect general advances in coating quality and performance, understanding of the behavior of coated systems, and more complete realization of the problems associated with the use of coated hardware. Programs to provide comparative evaluations of coatings on niobium and molybdenum alloys have pointed up some of the relative merits and deficiencies of the various coatings. Properties that have been studied and evaluated in recent investigations have included the following: (1) oxidation lives at various temperatures and pressures, (2) degradation in low-temperature ductility of substrates by coatings or coating processes, (3) degradation of mechanical properties by oxidation exposure (thermal stability) (4) effects of strain at low and high temperatures on protectiveness of coatings, (5) stress rupture and creep data of coated systems, (6) fatigue properties of coated systems, and (7) emittance of coatings. Although there is no "ideal" coating for a given application, the data now available may permit selection of a coating or coatings based on a balance of performance features such as those listed above. Continued detailed evaluation and general comparative programs are expected to greatly improve the ability to select a coating-substrate system best suited for given design requirements. Generally, the areas involving coated tantalum and tungsten alloy substrates are not so well developed; there are fewer coatings available and data are more limited. (auth)

20453 (HW-72415) NICKEL PLATING FUEL ELEMENTS BY A CHEMICAL DEPOSITION PROCESS — PILOT SCALE STUDIES. D. C. Brandt (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 24, 1962. Contract AT(45-1)-1350. 21p.

Aluminum-clad fuel elements were nickel-plated by chemical deposition in a small-scale experimental facility. The study was undertaken to gain experience in process and quality control. The effect of surface pretreatment and plating bath parameters on plate adhesion were investigated. (auth)

20454 (LADC-5561) LABORATORY TECHNIQUES FOR VERY HIGH PRESSURES AND THE BEHAVIOR OF METALS UNDER DYNAMIC LOADING. Robert G. McQueen (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 138p. (CONF-331-4)

From the Metallurgical Society of American Institute of Mechanical Engineers Annual Meeting, Dallas, Feb. 1963.

Particular attention is given to the production of very high pressures by colliding thin metal plates with stationary targets. Shock wave conservation equations are developed for this geometry that enable one to convert measurable quantities into equation of state data. Some results and techniques of high-pressure experiments are presented. Since the temperature rise behind a shock wave is not measurable, a brief description is given of how temperature estimates are made. Auxiliary experiments that support these calculations are also described. The hydrodynamic flow of the colliding plate experiment is outlined with attention given to the large dynamic tensions that can be produced. The effect of phase changes on the flow is also discussed, and it is shown how transition pressures can be determined by observing the free-surface motion of the target plate. The current work of several investigators on the elastic-plastic deformation of metal under dynamic conditions is reviewed and discussed with respect to calculational models and metallurgical studies made on shock-loaded specimens. (auth)

20455 (NAA-SR-Memo-9406) SRE-PEP TITLE I NUCLEAR ANALYSIS. D. S. Bost (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 9, 1964. Contract AT-11-1-GEN-8. 26p.

The third core loading of the SRE has as one of its main objectives the exposure of seven full scale uranium carbide fuel elements to 25,000 Mwd/MTU within a time period of about two years. In order to achieve this objective, a core loading of 33 eight-rod fuel elements and a core

power of 30 Mw(t) were specified. Three of the seven test elements have 0.5 inch rods and a ^{235}U enrichment of 15%. They will reach 25,000 Mwd/MTU in 14.5 full power months. The remaining four test elements have 0.6 inch rods and an enrichment of 6.5%. They will reach their exposure in 24 full power months. Twenty-six elements are used as drivers and are periodically replaced. These elements have 0.6 inch rods and 6.5% enrichment. Ninety driver elements are required for 24 full power months of operation. (auth)

20456 (ORNL-3593) MECHANICAL PROPERTIES OF SOME REFRACTORY METALS AND THEIR ALLOYS. H. E. McCoy, Jr., R. L. Stephenson, and J. R. Weir, Jr. (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 44p.

A critical evaluation has been made of the available mechanical property data for Nb-, Mo-, Ta-, and W-base alloys. It was found that insufficient data are available to allow the design and construction of complex engineering systems involving these materials. A general evaluation of the potential service temperatures for Nb-, Mo-, Ta-, and W-base alloys was made on the basis that conventional alloys have been used up to two thirds of their absolute melting point. Strengthening mechanisms that have been used to achieve high operating temperatures for conventional alloys and that could be applied to refractory alloys are discussed. A review of the literature on the effects of irradiation on the mechanical properties of niobium, molybdenum, tantalum, and tungsten has been made. It has been found that the existing data on this topic are rather scant. The data in general show that the ductility of molybdenum, tantalum, and tungsten is reduced after irradiation at ambient temperatures. The yield and ultimate strengths are increased slightly by irradiation. High-temperature tube-burst tests show that the rupture life of the Nb–1% Zr alloy is not drastically influenced by irradiation. (auth)

20457 (SWRI-1228-19) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 4, December 1, 1963–January 31, 1964. Robert D. Wylie (Southwest Research Inst., San Antonio). Mar. 31, 1964. Contract AT(11-1)-1228. 15p.

The serviceability of the Elk River Reactor pressure vessel is evaluated with respect to fabrication history, dissimilar weld metallurgy and geometry, irradiation on nil-ductility transition temperature, and fatigue properties of the completed vessel. The development of remote nondestructive testing equipment and techniques for the detection and monitoring of gross defects in critical areas of the vessel is discussed. The fabrication and mechanical properties of A105 grade II and A302 grade B steels are evaluated. (N.W.R.)

20458 (USNRDL-TR-717) THE SORPTION OF TRITIUM AND TRITIATED WATER VAPOR BY A FOAMED POLYVINYLCHLORIDE (ENSOLITE). S. Jacobs (Naval Radiological Defense Lab., San Francisco). Jan. 20, 1964. 27p. (AD-434218)

The sorption and subsequent desorption of tritium and tritiated water vapor by foamed polyvinylchloride (Ensolite) was examined under a variety of experimental conditions. Of primary interest was the elucidation of both the rates and total extent of the sorption and desorption under isothermal conditions. It was found that Ensolite sorbed both tritium and tritiated water vapor rapidly, achieving in most cases over 90% of the equilibrium value within 24 hr. The amount of tritium sorbed by Ensolite was found to be proportional to the initial gas-phase tritium concentration. The tritium desorbed readily, forming a gas-phase concentration that increased with the amount of tritium initially sorbed by the Ensolite. Repetitive (cyclic) desorption of tritium from Ensolite and desorption in a flow system yielded results that showed that the tritium would continually desorb until the amount remaining in the system was negligible. The sorption of tritiated water vapor by Ensolite was both much more rapid and extensive than the corresponding sorption of tritium. In a manner analogous to tritium, tritiated water vapor desorbed into a flow system until a very small amount of activity remained in the system. (auth)

20459 (EURAEC-954) USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 12, July 1 to September 30, 1963. (Société Belge pour l'Industrie Nucleaire, Brussels and Centre d'Etude l'Energie Nucléaire, Brussels). Nov. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 096-62-12 RDB. 61p. (A translation)

The powder intended for the fuel elements placed in the BR-3 power reactor was prepared in the form of a $(U,Pu)O_2$ mixture, obtained by sintering mixed and pelletized powders. Fabrication of BR-3 elements enabled a small-scale test of the method of fabrication and the equipment to be made. Nondestructive testing of the elements prepared did not reveal any important defects. A thermal simulation test was carried out on a UO_2 fuel element densified by vibration, and the tests were continued with samples of $(U,Pu)O_2$. Three samples of $(U,Pu)O_2$ mixed oxide ceramic fuel were exposed in the BR-2 reactor. Evacuation of the power generated during irradiation was estimated. Dissolving tests of PuO_2 pellets in nitric-acid medium showed that the dissolving rate is higher in the presence of HF than in the presence of NH_4F. ^{241}Am was separated during plutonium purification by ion exchange. (M.C.G.)

20460 (EURAEC-965) USE OF PLUTONIUM AS FUEL IN NUCLEAR REACTORS. Quarterly Report No. 13, October 1 to December 31, 1963. (Societe Belge pour l'Industrie Nucleaire, Brussels and Centre d'Etude l'Energie Nucleaire, Brussels). Jan. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 096-62-12 RDB. 63p. (A translation of BN-6401-03).

The fabrication of PuO_2–UO_2 fuel elements for BR-3 is reported. An improved method of plutonium hydroxide precipitation by ammonia was found and filtrate losses were considered. Homogeneity was determined for the plutonium content. Thermal conductivity measurements were performed on the fuel rods. Irradiation testing of the fuel was performed to determine burnup and power dissipation. Preliminary vibration and swaging testing of carbide-based fuels is reported. Plutonium recycling is discussed. (R.E.U.)

20461 STUDIES ON WORKABILITY, HEAT TREATMENT CHARACTERISTICS AND CORROSION RESISTANCE FOR PRESSURIZED WATER OF Zr–1% Mo–1% Cr AND Zr–1% Mo–1% Ni ALLOYS. Shigeo Aoki (Furukawa Electric Co. Ltd., Tokyo). Nippon Kinzoku Gakkaishi, 28: 22-7 (Jan. 1964). (In Japanese)

Workability, effects of the heat treatment on the mechanical properties and the microstructures, and the corrosion resistance for pressurized water of Zr–1% Mo–1% Cr and Zr–1% Mo–1% Ni alloys were investigated

in comparison with Zircaloy-2. Percent reductions of the alloys drop-forged in the temperature range of 600 ~ 900°C were nearly the same as those of Zircaloy-2. The alloys were cold rolled by 70% without any intermediate annealing. Remarkable hardening occurred in both alloys when they were quenched from β phase. Optimum procedures of the heat treatment to obtain the favorable mechanical properties of Zr–1% Mo–1% Cr and Zr–1% Mo–1% Ni alloys were to temper them at 750 and 600°C for 100 min, respectively, after quenching from 950°C in β phase. The weight gain of Zr–1% Mo–1% Cr alloy over the corrosion period of 500 hr in pure water at 300°C under pressure of 80 kg/cm^2 was a little higher than that of Zircaloy-2 but much lower than that of Zr–1% Mo–1% Ni alloy. (auth)

20462 PROPERTIES AND FABRICATION OF COMMERCIAL BERYLLIA CERAMICS FOR NUCLEAR APPLICATIONS. Raymond J. Brown and N. W. Bass (Brush Beryllium Co., Cleveland). 31p. (CONF-281-28)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Progress was made in improving the properties of commercial beryllia ceramics for both nuclear and other uses. Much of this property improvement, and property consistency, resulted from the application of ceramic processing techniques to beryllia. These same techniques permitted drastic reductions in cost, which make beryllia economically feasible for both present and future reactor designs. (auth)

20463 DEVELOPMENT AND MANUFACTURE OF MAGNOX FUEL. J. C. C. Stewart (United Kingdom Atomic Energy Authority, Risley, Eng.). 20p. (CONF-480-1).

From Ordinary Meeting of the Institution of Mechanical Engineers, London, Nov. 1963.

The stages in design, development, and manufacture that led to the successful introduction of magnox fuel into the first phase of the British nuclear program are described. Significant design problems are discussed and attention is directed towards the main limitations in fuel performance and endurance. Detailed results of fuel irradiation trials are presented and future developments are discussed. (auth)

20464 RECENT PROGRESS IN SODIUM TECHNOLOGY. W. J. Hallett (Atomics International, Canoga Park, Calif.). 11p. (CONF-467-4)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

Progress over the past year in U. S. laboratories studying some of the materials and engineering problems that must be resolved in bringing the technology of sodium to an economically and technically attractive point is reviewed. The status of sodium cooled power reactors in the U. S. is described. (P.C.H.)

20465 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUELS. Harry John Hedger and Jack Williams (to United Kingdom Atomic Energy Authority). British Patent 954,939. Apr. 8, 1964. Filed Nov. 3, 1961.

A cermet composition is described which melts below 1600°C and consequently can be prepared by casting. The cermet comprises a dispersion of UN in Fe with a small U metal content; its preferred composition is 12 to 18 at. % U, 12 to 17 at. % N, and balance Fe, and the atomic ratio of N to U is at least 0.8. For use as fuel for fast reactors, up to 50% of the UN content may be replaced by an equivalent weight of PuN. (D.L.C.)

20466 IMPROVEMENTS IN OR RELATING TO THE PRODUCTION OF BERYLLIUM. Robert Derek Crook, and Derek Geldart (to United Kingdom Atomic Energy Authority). British Patent 955,138. Apr. 15, 1964. Filed Aug. 12, 1959.

A process is given for the electrolytic production of beryllium. The process comprises heating BeOH in a fluidized bed to convert it into BeOH, mixing the BeOH with C, compacting the BeO + C into pellets, chlorinating the pellets to form $BeCl_2$ vapor, passing the $BeCl_2$ vapor into depleted anhydrous $BeCl_2$–NaCl melt, and electrolyzing the replenished melt. (D.L.C.)

20467 IMPROVEMENTS IN OR RELATING TO THE PREPARATION OF URANIUM MONOCARBIDE POWDER. Pierre Blum and Claude Moreau (to Commissariat à l'Energie Atomique). British Patent 955,708. Apr. 15, 1964. Priority date Aug. 5, 1959, France.

A process is given for obtaining a sinterable powder of pure UC. The process comprises a series of two treatments: carburization of U powder with a gaseous hydrocarbon at <950°C until the carbon content in the powder corresponds to UC (4.8% C), and heat treatment of the carburized powder without hydrocarbon at <950°C to transform it into pure UC by diffusion of C. The carburizing hydrocarbon is preferably methane, butane, or propane. The best conditions for the process are: fine particle size of initial U powder (1 to 100 μ), continuous stirring of the powder during the reaction, rapid elevation of temperature to 700 to 900°C for the reaction in argon or vacuum, carburization for 1 to 2 hr with an amount of hydrocarbon at least 10 times the stoichiometric amount, diffusion treatment for 3 to 5 hr, and cooling in argon or vacuum. An apparatus is described for stirring the powder. (D.L.C.)

Corrosion

Refer also to abstract 20873.

20468 (AROD-2734:2) THE MECHANISM OF OXIDE FORMATION IN THE INITIAL STAGES OF OXIDATION. Report No. 13. Final Report. D. W. Rausch, K. L. Moazed, and M. G. Fontana (Ohio State Univ. Research Foundation, Columbus). Mar. 6, 1964. Contract DA-33019-ORD-3387. 6p.

The initial mechanisms of the oxidation of tantalum and tungsten by oxygen at 30 to 1100°C are studied in order to determine the role of chemical, physical, and structural factors. Such factors as adsorption, nucleation, oxide growth, surface diffusion, crystal structure, oxygen pressure, impurities, and temperature are evaluated. (N.W.R.)

20469 (CEA-2385) CORROSION DE MATERIAUX METALLIQUES PAR L'HEXAFLUORURE D'URANIUM A HAUTE TEMPERATURE (theses). Corrosion of Metallic Materials by Uranium Hexafluoride at High Temperatures (thesis)). G. Langlois (France. Commissariat a l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). 1963. 119p.

The corrosion by UF_6 of nickel, Monel, Inconel, gold, platinum, stainless steel, is studied in the temperature range from 300 to 1000°C. The test method, designed to avoid heating the apparatus containing the corrosive fluid to a high temperature, consists in using thread-like samples heated by the Joule effect, the rest of the apparatus being maintained close to room temperature. This technique makes it possible also to determine continuously the

penetration of the corrosion by measuring the electrical resistance of the sample with a double Thomson bridge. A series of rapid comparison tests shows that stainless steel, precious metals, and Inconel are attacked far too rapidly to be used above 500°C; only Monel and especially nickel appear capable of resisting at high temperatures. The detailed examination of the behavior of nickel shows that the metallic fluoride is volatilized and that this influences the corrosion rate. It shows also the existence of a temperature zone situated between 550 and 700°C in which occurs a strong intergranular corrosion the cause of which appears to be the presence of impurities in the metal. (auth)

20470 (CONF-492-1) EFFECTS OF SURFACE GRINDING ON STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEEL IN LOW-CHLORIDE WATER. R. P. Jackson (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Mar. 5, 1964]. Contract AT(07-2)-1. 13p.

From the National Association of Corrosion Engineers, Chicago, Mar. 1964.

Laboratory tests demonstrated that austenitic stainless steel becomes susceptible to stress-corrosion cracking in dilute sodium chloride solutions (>2 ppm) when the surface of the metal has been dry ground with an abrasive grit. Applied stress is not required to produce these cracks. Two stages of transgranular crack development were observed. First, visible anodic sites formed on the specimen surface in areas where inclusions were present, and cracks initiated at these sites. Second, corrosion occurred within the crack and hydrolysis of corrosion products produced an acid condition. As corrosion continued, subsurface pitting occurred. (auth)

20471 (CONF-492-2) EFFECTS OF pH ON STRESS CORROSION CRACKING OF 18-8 STAINLESS STEEL IN LOW-CHLORIDE WATER. S. P. Rideout (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Mar. 5, 1964. Contract AT(07-2)-1. 19p.

From the National Association of Corrosion Engineers, Chicago, Mar. 1964.

Tests to determine the effects of pH on cracking behavior of sensitized samples of 18-8 stainless steel were performed in 90°C water with 10 ppm chloride ion and pH in the range 7.0 to 0.0. The results demonstrated that pH exerts a strong influence on cracking. Tests on nonsensitized type 304 steel immersed in boiling water with 100 ppm chloride ion over the range of pH 7.0 to 0.0 revealed that steel in this condition is much more resistant to cracking than sensitized-and-pickled steel. The results demonstrate the importance of electrochemical corrosion in the phenomenon of stress corrosion cracking of type 304 stainless steel. (P.C.H.)

20472 (NAA-SR-Memo-9340) MATERIALS FOR MECHANISMS OPERATING IN 1200°F SODIUM. S. E. Sarnecki (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 18, 1963. Contract AT(11-1)-Gen-8. 12p.

Tests performed with gears and sleeve-type bearings operating in 1200°F sodium have shown that Hastelloy C shafting with molybdenum journals and paired Hastelloy C gearing are the most promising material combinations for 1200°F sodium service. (auth)

20473 (NASA-CR-54008) POTASSIUM CORROSION TEST LOOP DEVELOPMENT. Quarterly Progress Report No. 2, October 15, 1963–January 15, 1964. E. E. Hoffman, ed. (General Electric Co. Spacecraft Dept., Cincinnati). Contract NAS3-2547. 34p.

The design and development of corrosion test loops for studying refractory alloys in boiling and condensing sodium and potassium are summarized. The design and fabrication of Component Evaluation Test Loop II, the single-phase forced-circulation sodium loop, operated at 2100°F are completed. The design of the Pre-prototype Corrosion Test Loop, a two loop system is being continued. Test Loop I, the natural convection sodium loop, is being helium leak tested and baked out at 250°F. The helium purification system and helium analysis system are described and evaluated. (N.W.R.)

20474 (TID-12794) INTERMEDIATE-TEMPERATURE BEHAVIOR OF Cb–Al ALLOYS. C. S. Wukusick (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Mar. 27, 1961. Contracts AT(11-1)-171 and AF33(600)-38062. 31p. (XDC-61-4-54)

The spalling of Cb–Al alloys at temperatures from 1000 to 1800°F has been studied. The phenomenon is due to stress-corrosion where the stresses are caused by the oxide which forms. The addition of Ti has been found to prevent the phenomenon. (auth)

20475 (VDDIT-87) CORROSION-RESISTANT NIOBIUM ALLOYS. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Mar. 1964. 30p.

Fifty-seven abstracts concerning niobium alloys which may be useful as cladding material for water cooled reactors, especially for nuclear superheaters, have been assembled. The material presented in this survey has been divided into two parts. The first part contains abstracts of papers originating from Battelle Memorial Institute, as the most important work has hitherto been carried out there; the second part presents papers from other sources. This survey is to be considered as a supplement to VDIT-34 from March 1961. (auth)

20476 (EURAEC-916) ZIRCONIUM AND ALLOYS. Quarterly Report No. 7, October 1–December 31, 1963. (Compagnie Pechiney, Paris). Jan. 31, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 067-62-4RDF. 72p. (A translation)

Zirconium–tin–vanadium alloys were corrosion tested in steam at 350, 400, and 480°C. The corrosion rates noted were comparable with those of Zircaloy-2 and the oxide layer was black and shiny. Photographs are included. Mechanical properties of Sn–V–Zr alloys at 20, 200, 500, and 700°C are shown in tables and graphs. The V–Zr alloys were examined by electron micrography and the structure is shown in photographs. The beginning of ZrV_2 formation was observed. (M.C.G.)

20477 STRESS CORROSION CRACKING OF AUSTENITIC STAINLESS STEEL IN URANYL SULFATE SOLUTIONS. J. L. English and J. C. Griess (Oak Ridge National Lab., Tenn.). Corrosion, 20: 138t-44t(Apr. 1964).

The effects of a number of variables on the stress corrosion cracking behavior of two different heats of Type 347 stainless steel were examined in simulated aqueous homogeneous reactor fuel solution containing low concentrations of chloride ions. The fuel solution consisted of uranyl sulfate, sulfuric acid, and copper sulfate. Tests were conducted in the temperature range of 50 to 101°C. Although the two heats of stainless steel were nearly identical in composition, specimens from one heat were consistently more susceptible to cracking than specimens from the second heat. Chloride concentrations of 25 to 500 ppm were equally effective in producing cracks. The higher the dissolved oxygen content in solution, the more numerous

and intensive were the cracks. Cracking was still observed, however, in the absence of oxygen. Uranyl sulfate concentration was an important variable; at concentrations of 0.40M and greater, no cracking took place with chloride present. Sodium dichromate was found to be an effective cracking inhibitor. Pretreatment of specimens in chloride-free fuel solution either before or after stressing greatly reduced cracking susceptibility during subsequent exposure in the fuel solution containing added chloride. (auth)

20478 INVESTIGATION OF THE OXIDATION OF Ni_3Al-Ni_3Nb ALLOY SYSTEMS. M. P. Arbuzov and V. G. Chuprina (Kiev Inst. of Aeronautics). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 93-8(1964). (In Russian)

The oxidation of the alloy system Ni_3Al-Ni_3Nb as a function of time is investigated. The effect of Nb content and temperature on the oxidation rate is also studied. (C.E.S.)

20479 THE OXIDATION KINETICS OF ZIRCONIUM IN THE TEMPERATURE RANGE 400° – 600°C. J. Electrochem. Soc., 111: 564-8(May 1964).

The oxidation kinetics of zirconium were determined in the temperature range 400–600°C at subatmospheric pressures for exposure times of 650 hr at 400°C to 160 hr at 600°C by a microbalance technique. From scale thickness measurements, it was found that at temperatures between 500–600°C the amount of oxygen in the metal varies from 14 to 23% of the total oxygen consumption, respectively. Further both the oxidation kinetics and the oxygen distribution between the metal and the oxide were found to be independent of changes of oxygen pressure from 0.25 to 50 cm Hg. The kinetics were fitted to a parabolic rate relation after an initial deviation. In the parabolic range, oxidation behavior approximated to a model in which the oxidation rate was determined by oxygen diffusion in both the oxide and metal. (auth)

20480 AN APPARATUS FOR GRAVIMETRIC DETERMINATION OF THE EFFECTS OF LOW PRESSURE OXIDATION. R. W. Harrison and E. J. Delgrosso (Pratt and Whitney Aircraft, Middletown, Conn.). J. Sci. Instr., 41: 222-4(Apr. 1964).

The design and capabilities of an apparatus for measuring small weight changes continuously during the oxidation of metals and alloys at oxygen pressures down to 0.1 μtorr are described. The oxidation specimen was connected to a calibrated spring, and its extension could be detected accurately by a magnetic transducer coupled to an amplifier and recorder, so that weight gain or loss could be measured to ±0.1 mg. Control of the oxygen pressure for long periods of time is a most critical factor in this type of test. Proper control is achieved by an adjustable leak through a micrometer needle valve from an oxygen reservoir at 1 torr. As an example, niobium tested at 1200°C in oxygen at 10 μtorr was observed to ipcrease in weight at a linear rate of 0.38 mg cm^{-2} hr^{-1} over a ten-hour period. (auth)

20481 CORROSION-RESISTING FILMS OF TITANIUM AND ZIRCONIUM IN HIGH TEMPERATURE WATER AND SEVERAL AQUEOUS CHLORIDE SOLUTIONS. Tadayuki Nakayama, Hiroyuki Yamada, Eiichi Yagi, and Junichi Yasui. Nippon Kinzoku Gakkaishi, 27: 318-23(1963). (In Japanese)

Corrosion-resisting films and surfaces produced on Ti and Zr were studied by the electron microscopic and diffraction method. The corrosion-resisting films of Ti produced in high temperature water (200°C, 6 hr) consist of rutile and anatase. Zr plate was covered with monoclinic and cubic type ZrO_2 crystals showing the preferred orientations of their {110} and {100} planes parallel to metal surfaces, but these oriented films were not found on the cast specimens under the same conditions. The protective films of Ti immersed in boiling 10 and 28 wt % NaCl solutions consist of anatase or anatase and rutile, respectively. The surface films produced on Ti in artificial sea water and 10 wt % NaCl solution (200°C, 6 hr) were composed of rutile and anatase, and the surfaces were individually protected with rutile or rutile and-α-Ti_2O_3 when the specimens were corroded in high temperature 20 or 28 wt % NaCl solution. Zr plates dipped in artificial sea water, 10 ~ 28 wt % NaCl solutions (200°C, 6 hr) or boiling 10 wt % $AlCl_3$, $MgCl_2$, and NH_4Cl solutions were covered with the oriented ZrO_2 films. Rutile was found on Ti surface dipped in boiling 10 wt % $FeCl_3$ solution, while the films consisting of rutile and anatase were detected on the surfaces of Ti boiled in 10 wt % $CuCl_2$ solution. However, the protective films of Ti in boiling 10 wt % $AlCl_3$, $MgCl_2$, and NH_4Cl solutions were composed of anatase. (auth)

20482 CORROSION OF BINARY AND TERNARY MAGNESIUM ALLOYS WITH RARE EARTHS AND OTHER ELEMENTS. M. A. Timonova and T. I. Ershova. Zh. Prikl. Khim., 37: 590-5(Mar. 1964). (In Russian)

The effects of various admixtures on the corrosion resistance of magnesium were studied with the addition of 0.5, 1, 3, and 6% Ga to Mg and Mg–Nd alloys; the addition of 1, 2, 3, 6, and 12% In to Mg–Al, Mg–Zn, and technical Mg; and the addition of 0.1 to 0.5% Co to Mg–Nd alloy. The results showed that the addition of 1 to 12% In to Mg and Mg–Al and Mg–Zn alloys in humid atmosphere and 0.5% NaCl reduce the corrosion resistance of the above metals. Additions of 0.1 to 0.5% Co to Mg–Nd alloy also reduced its corrosion resistance. A similar effect was produced by additions of Ni into deformed Mg–Nd and Mg–Nd–Mn alloys. (R.V.J.)

Fabrication

20483 (AAEC/E-116) SINTERING STUDIES ON CERAMIC FUEL MATERIALS. K. D. Reeve and K. A. Jones (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Jan. 1964. 12p.

Satisfactory dense crack-free dispersions of spheroidal UO_2-ThO_2 particles in BeO can be produced by "co-sintering," a process in which unsintered particles are hydrostatically pressed in BeO and the dispersion is sintered in one step. The large voids and cracks in dispersions of fully sintered particles in BeO following sintering are related to mismatched sintering shrinkage between the two phases; they are probably indicative of a high interfacial energy between the two phases. Co-sintering has been used for individual fabrication of specimens for irradiation testing, but is not immediately applicable to large-scale fabrication of fuel element shapes. Possible modifications of the method are discussed. (auth)

20484 (AD-418992) COLUMBIUM ALLOY SHEET ROLLING PROGRAM. Interim Report No. 3, July 7, 1963 – September 6, 1963. W. O. Gentry and H. A. Moreen (Fansteel Metallurgical Corp., North Chicago, Ill.). Sept. 7, 1963. Contract NOw 63-0231-c. 8p.

Conversion of nominal 6-inch diameter by 300 pound ingots of FS-85 and B-66 to sheet bar is completed. Data on this conversion are presented. (auth)

20485 (ASD-TDR-62-670(Pt.II)) THE EXTRUSION, FORGING, ROLLING, AND EVALUATION OF REFRACTORY ALLOYS. G. A. Reimann, D. R. Carnahan, and J. A. Visconti (Westinghouse Electric Corp., Blairsville, Penna.). Nov. 1963. Contract AF33(616)-8325. 106p.

Wrought bars of tungsten-base alloys were produced by extrusion of arc-cast billets under a variety of conditions. Billets of W + 0.6Cb alloy were successfully extruded using temperatures between 3200 and 4200°F and reduction ratios between 3.9:1 and 8.3:1. A comparison was drawn between W + 0.6Cb extrusions produced from material melted by four suppliers. Differences in material characteristics could be traced to electrode suppliers. The W + 6Mo + 2Cb alloy was extruded between 3400 and 4200°F using ratios from 4.1:1 to 7.4:1. Surfaces were generally fair to poor and internal cracks were discovered in many extrusions. Machining billets from 4-inch ingots instead of 3½-inch ingots produced only a slight improvement in extrusion quality. Instrumentation of the extrusion press to measure ram load, die load, and ram position has enabled a realistic determination of container friction and a modification of basic extrusion theory. Jacketing tungsten-base billets with molybdenum was found more advantageous than applying glass as a lubricant, particularly at elevated temperatures. While swaging has been the most successful method for reduction of tungsten-base extrusions, higher tensile properties were obtained at 3000°F on forged material (46,200 vs. 63,300 psi for W + 0.6Cb). An ultimate strength of 48,200 psi was obtained on swaged W + 6Mo + 2Cb alloy. (auth)

20486 (MTA-15) MARK-1 SOLID BISMUTH TARGET FABRICATION BY IMMERSED CASTING. G. B. Rosenblatt, Jr. and G. M. Kibler (California Research and Development Co. Livermore Research Lab., Livermore). Jan. 9, 1953. Contract AT(11-1)-74. 89p.

The design of a solid bismuth target for ^{208}Po production by the p,2n reaction on ^{209}Bi required that thirty target sections 8⅛ inches wide by approximately 20 feet in length be arrayed in echelon to intercept a 30 Mev proton beam from the Mark I MTA linear accelerator. A single target section consisted of an 0.065 inch plate of bismuth sandwiched between aluminum plates and metallurgically bonded at the interfaces. A method was developed to produce target sections of the required high bond quality (flaws less than ½ inch in diameter at the cover bond, 1/16 inch in diameter at the back bond) at a satisfactory rate. An immersed casting procedure was studied in which the bonding and the "sandwich" formation were accomplished under the surface of molten bismuth. The fabrication procedure consisted in removing the aluminum oxide, by mechanical abrasion, from the aluminum surfaces to be bonded, after which wetting of the aluminum surfaces by the bismuth produced metallurgical bonds. The opposed "wetted" surfaces were then brought together, enclosing the proper amount of bismuth, to form the target section which was then water quenched; specified dimensions were maintained by application of sufficient pressure. This report also includes the results of extrusion development, for fabrication of the target back plate, the design of both laboratory and pilot scale (¼ size target sections) fabrication equipment and the results of the operation of such equipment. Development of welding of cover plate to back plate is likewise included. From the evidence obtained the following conclusions were drawn: (1). Sections of the Mark I solid bismuth target for ^{208}Po production can be prepared by the immersed casting method. Sections so produced are well within design tolerance for bismuth dimension and bond quality. (2). Sufficient information has been obtained to permit design of a workable full scale production plant for fabricating target sections at the required rate. (3). Target back plates should be obtainable by extrusion alone or by a combination of extrusion and milling operations. (4). It is possible to complete the target sections by satisfactory edge welding of cover plate to back plate. Further, but minor, development work on extrusion, welding, and the operations involved in immersed casting, is desirable prior to design of a full scale plant for target fabrication in order that optimum conditions and methods may be used. Future development work on this project has not been programmed because of the revised status of the Mark I ^{208}Po program; nevertheless recommendations for completion of this work have been included. (auth)

20487 (WANL-PR-(N)-002) DEVELOPMENT OF HIGH STRENGTH COLUMBIUM AND TANTALUM ALLOY TUBING. Quarterly Progress Report No. 2, March 1, 1962–May 31, 1963. R. W. Buckman, Jr. (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). July 12, 1963. Contract AT(30-1)-3108. 34p.

The evaluation of the extrudability of B-66 (Nb–5V–5Mo–1Zr) and T-111 (Ta–8W–2Hf) at a reduction ratio of 7:1 was accomplished. An evacuated mild steel can was used as cladding for the extrusion billets. Both B-66 billets were extruded at 2200°F, using ram speeds of 275 and 1000 inches per minute. The billet extruded at a ram speed of 275 inches per minute exhibited slight rattlesnaking for 6 inches near the nose end, with the balance of the as-extruded surface smooth and free of defects. Increasing the ram speed to 1000 inches per minute resulted in moderate rattlesnaking and circumferential cracking the entire length of the billet. The depth of the cracks was 0.020-0.040 inches. The extrusion constant for B-66, based on the running pressure, was 78–84 ksi. The initial T-111 billet was extruded at 2200°F and at a ram speed of 175 inches per minute. The as-extruded surface was smooth and free of defects. Increasing the temperature to 2300°F and the ram speed to 1000 inches per minute resulted in slight rattlesnaking over a 6-inch length approximately 6 inches from the nose end. The balance of the extrusion was free of defects. The increase in extrusion temperature and ram speed decreased the extrusion constant for T-111 from 84 ksi at 2200°F to 80 ksi at 2300°F. Results of the extrusion evaluation, using solid billets, indicate that the extrusion of tubular billets of B-66 and T-111 at 7:1 reduction ratios is feasible using the mild steel cladding technique. A portion of the B-66 solid rod extrusion was conditioned and after heat treatment will be gun drilled. This starting tubular shape will be used to evaluate the hot drawing characteristics of B-66. (auth)

20488 (EURAEC-970) ELECTRO-SLAG WELDING OF REACTOR STEELS. Quarterly Report No. 11. (Schweisstechnische Lehr- und Versuchsanstalt, Duisburg, Germany). Feb. 7, 1964. Work Performed under United States–Euratom Joint Research and Development Program. 110p. (A translation).

Analyses were made of electroslag joining welds performed on ASTM 302 grade B steel with welding rod S 3/Mo + 2.5% Ni + a little Mn and on 13 CrMo 44 steel with welding rod S 2/CrMo. Microtexture photographs are shown. References from Russian literature on electroslag welding are presented in abstract form. (R.E.U.)

20489 A COMPARISON BETWEEN STEAM-SINTERING AND HYDROGEN SINTERING OF URANIUM DIOXIDE PELLETS. I. Amato, R. L. Colombo, and A. M. Protti

(FIAT, Turin). Energia Nucl. (Milan), 11: 121-8(Mar. 1964).

Steam sintering of UO_2 bodies was examined mainly on technological grounds, and was compared with conventional hydrogen sintering. Though advantages of steam sintering were evidenced, the conclusion was reached that there is little hope that it may be a cheaper substitute for hydrogen sintering. In the course of the research work, a limited amount of basic information on the sintering mechanism was also gained. (auth)

20490 WELDING OF ALUMINUM FOR REACTOR CONSTRUCTION. W. van Dassen. Kerntechnik, 6: 111-14(Mar. 1964). (In German)

The difficulties in aluminum welding can be controlled by gas-torch welding and by the WIG-method. Experiences in the application of these methods in aluminum welding with or without support are reported, and the advantages and disadvantages in the use of fluxing agents of Cl-basis are outlined. (auth)

20491 ELECTRON BEAM MELTING AND WELDING IN NUCLEAR TECHNOLOGY. W. Dietrich, H. Stephan, and H. Kluger (W. C. Heraeus GmbH, Hanau, Ger.). Kerntechnik, 6: 119-24(Mar. 1964). (In German)

Methods and uses of electron-beam melting and welding are discussed. Purification of metals by electron-beam melting is described. Methods of fuel-element welding using electron beams are outlined. Diagrams and pictures of equipment and products are included. (M.C.G.)

20492 APPLICABILITY OF THE ELECTRON BEAM WELDING TECHNIQUE TO THE FABRICATION OF PARTICULATE TYPE FUELS. H. Bairoit (Société Belge pour l'Industrie Nucleaire, Brussels) and Ph. Van Asbroeck. Kerntechnik, 6: 124-6(Mar. 1964).

Studies were made on the use of electron-beam welding in the fabrication of plutonium bearing fuel elements. It was concluded that electron-beam welding is applicable to particulate ceramic type elements and offers all the advantages attached to that process. However, the difficulty of manipulation inside glove boxes tends to limits its application. It can, however, be of a great help on account of its versatility, for instance in correcting or repairing welds performed by rougher methods and found to be defective. (P.C.H.)

20493 STUDY ON THE PREPARATION OF URANIUM CARBIDES. Kazuo Yamamoto (Mitsubishi Atomic Power Industry, Inc., Omiya, Japan). Nippon Genshiryoku Gakkaishi, 6: 134-43(Mar. 1964). (In Japanese)

By heating a mixture of UO_2 and graphite in vacuum at 1600 to 2000°C, UC or UC_2 without unreacted UO_2 was obtained. Each of these carbides was milled in hexane, compacted into shapes in argon atmosphere, and then sintered in vacuum (10^{-4} mm Hg) at 1800 to 2000°C. High purity and high density (95% th.D.) pellets were thus obtained. The sintered pellets were examined by carbon analysis, metallographic observation, and x-ray diffraction. It was found that UC sintered pellet had a monophase structure with a grain size of 50 ~ 100 μ and the stoichiometric composition. UC_2 sintered pellet was composed of UC_2 phase with grain size of 50 ~ 100 μ and UC phase of about 10%. Sinterability of UC_2 markedly decreased with increasing carbon content in the range of 8.6 to 8.9%. This change was attributed to the presence of free carbon. Maximum carbon content of UC_2 phase at the temperature range of 1800 to 2500°C was determined as 8.6 ± 0.1 wt %, that is, the composition of this phase could be expressed as $UC_{1.86 \pm 0.02}$. The kinetics of transformation of cubic UC_2 to tetragonal was regarded as a martensitic diffusionless one. (auth)

20494 MOLECULAR PLATING. I. A RAPID AND QUANTITATIVE METHOD FOR THE ELECTRODEPOSITION OF THORIUM AND URANIUM. W. Parker, H. Bildstein, and N. Getoff (Österreichische Studiengesellschaft für Atomenergie, Seibersdorf, Austria). Nucl. Instr. Methods, 26: 55-60(Feb. 1964).

A method that has been used for the electrodeposition of thin and uniform inorganic films is considered. The results obtained from an investigation dealing with the possibility of employing this particular method for the quantitative preparation of thorium and uranium samples are reported. Parameters principally investigated have been the voltage-current-time dependence, and influence of solution, cathode material, and pH. Photomicrographs are presented showing that thin film uniformity comparable to that obtainable by vacuum deposition can be simply and rapidly achieved. In conclusion the general principles of the method are discussed, and its possible application to the preparation of other elements put forward. (auth)

20495 MOLECULAR PLATING. II. A RAPID AND QUANTITATIVE METHOD FOR THE ELECTRODEPOSITION OF THE RARE-EARTH ELEMENTS. W. Parker, H. Bildstein, N. Getoff, H. Fischer-Colbrie, and H. Regal (Österreichische Studiengesellschaft für Atomenergie, Seibersdorf, Austria). Nucl. Instr. Methods, 26: 61-5 (Feb. 1964).

The rapid and quantitative electrodeposition of the rare-earth elements cerium, praseodymium, neodymium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, and ytterbium by means of molecular plating is discussed. Apart from the rapid and quantitative nature of the described method a number of other advantages are also offered, such as the excellent uniformity of the deposited material, good adhesion to the cathode, which may take the form of aluminum, copper, silver, etc., and the simplicity of the method. The results of the investigation are summarized in table form, together with curves illustrating sample uniformity obtained under various conditions. In conclusion the general principles of the method are discussed. (auth)

20496 BERYLLIUM INGOT SHEET. John P. Denny and George E. Meyer. 10p. (CONF-375-7)

From 6th National Symposium, Society for Aerospace Material and Process Engineers, Seattle, Nov. 1963.

Investigations showed that it is now possible to convert sound beryllium ingots directly into sheet. The process offers a more direct route to a finished product with a lower inclusion count and better formability than conventional powder metallurgy material. In accordance with the present state of the art, these gains are achieved with a concurrent decrease in strength properties. The production of sound beryllium ingots suitable for fabrication is described, and primary work and finish rolling are discussed. Experimental data are presented, and possible areas of application are indicated. (P.C.H.)

20497 STUDIES OF THE FABRICATION OF FUELLED BERYLLIA BY EXTRUSION AND SINTERING. G. E. Christie, J. Jackson, G. A. Lyon, D. G. Cragg, and F. S. Martin (United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng.). 36p. (CONF-281-33)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Fabrication studies of a beryllia-based reactor fuel are

described. Cold-extrusion techniques and a fuel concentration of 30 vol % UO_2 were chosen. A continuous network of high-density beryllia surrounding dense UO_2 fuel particles is prepared bonded to a beryllia sheath and end caps. Cold pressing and sintering studies, cold extrusion, extrusion of fueled beryllia, co-extrusion trials, and end sealing of co-extruded rods are discussed. Graphs and pictures are included. (M.C.G.)

20498 FABRICATION AND STRUCTURE OF BERYLLIUM OXIDE BASED FUELS. K. D. Reeve (Australian Atomic Energy Commission). 22p. (CONF-281-32)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

A specification for the optimum structure of dispersion type fuels was developed from consideration of the effect of microstructural variations on performance. To achieve this structure, maximum control of the microstructure of both fuel and matrix is necessary during the fabrication process. For concentrated dispersions, either hot-pressing or a "co-sintering" process is required for crack-free, void-free structures. In relatively dilute dispersions such structures may be more readily achieved using fully sintered fuel particles and this process has the advantage of providing independent control over the microstructure of the two phases. Extrusion and sintering may offer some slight advantages over cold-pressing and sintering for achieving void-free structures. An initial assessment of the effects of particle additions on the strength of hot-pressed BeO indicated that the particles behave as voids, but this result may be pessimistic. Suggestions are made for improving the strength of dispersion fuels by improving the bonding between fuel and matrix. (auth)

20499 THE DEVELOPMENT OF A TECHNIQUE FOR EXTRUSION AND SINTERING OF BERYLLIA. J. Bardsley and A. Ridal (Australian Atomic Energy Commission). 23p. (CONF-281-27)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The development of an extrusion and sintering technique for the production of fine grain-size BeO of at least 95% theoretical density is discussed. In this process Brush UOX powder, mixed with 2 wt % glycerine, and 17 wt % water is extruded under a pressure of 7000 psi, dried at 80°C, baked at 800°C, and subsequently sintered in an atmosphere of dry nitrogen (less than 100 ppm water vapor). The effects of sintering time in the range 1300 to 1700°C on density, grain size, microstructure, preferred orientation, and room temperature bend strength are reported and discussed. An average bend strength of 34,000 psi was attained for material with a grain size of 5 microns after sintering for 5 hours at 1350°C to a density of 2.90 g/cm^3. Variations in type and content of plasticiser, mixing procedure, die entrance angle, and in drying and firing cycles were incorporated into the process and their effects on the quality of the sintered material are reported. Process modifications are proposed, which should yield improvements in the structural homogeneity and mechanical properties of the sintered product. (auth)

20500 THE KINETICS OF SINTERING AND GRAIN GROWTH OF BERYLLIA. M. J. Bannister (Australian Atomic Energy Commission). 20p. (CONF-281-9)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

A grade of sulfate-derived beryllium oxide (Brush UOX), hydrostatically pressed at 20 ton/in.^{2} without a lubricant or binder, was sintered for various times in vacuum at 1290°C to 1700°C to determine the kinetics of sintering and grain growth. Under certain conditions, the sintering results obeyed the relationship: $2.50 \log_{10} P + \log_{10} t = -10.97 + (116{,}000/RT \log_e 10)$, where P is the percentage porosity, t minutes is the time at T°K, and R cal deg C^{-1} mole^{-1} is the gas constant. This equation was obeyed at 1290 to 1600°C for singering times of 10 to 1000 minutes, provided that the final density did not exceed 98% theoretical. The measured grain size obeyed the equation: $2.22 \log_{10} G - \log_{10} t = 12.86 - (114{,}000/RT \log_e 10)$, where G is the grain size in microns and t minutes is the time at T°K. This relationship was obeyed at 1500 to 1700°C for times of 10 to 200 minutes and grain sizes of 1.5 to 15 microns. The activation energy for sintering was 116 ± 10 kcal/mole, and for grain growth was 114 ± 10 kcal/mole. Volume diffusion of Be in the oxide is believed to control the rates of both processes. (auth)

20501 SINTERABILITY STUDIES ON VARIOUS BeO POWDERS. M. J. Bannister (Australian Atomic Energy Commission). 17p. (CONF-281-50)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Six commercial grades of beryllia were examined in a study relating sinterability of beryllia to powder properties. Surface area, crystallite size and shape, aggregate size and shape, pour density, tap density, and impurity contents of each powder were measured. Sinterability was assessed using pellets of as-received powders pressed without a binder at 20 tons/in.^{2} and sintered for one hour at 1500, 1600, and 1700°C in either dry flowing nitrogen, dry flowing hydrogen, or in vacuum. In general, hydroxide- and acetate-derived powders sintered less readily than sulfate-derived material. Some hydroxide-derived powders retarded the sintering of sulfate-derived powder when compacts of the two types were sintered together in a flowing atmosphere furnace; this effect was not noted during vacuum sintering under similar conditions. Some powders sintered to higher densities in nitrogen than in hydrogen. The results are discussed and are shown to indicate the importance of residual anion content in affecting the sinterability of BeO. In some cases, the nature of the aggregates in the original powder also seems to be important. (auth)

20502 STUDIES IN THE COLD PRESSING AND SINTERING OF BERYLLIA. T. E. Clare (Australian Atomic Energy Commission). 20p. (CONF-281-26)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

A six-stage process was developed for the production of simple BeO shapes of high density by die-pressing and sintering. A binder-lubricant combination of 2 wt. % camphor, 1 wt. % polyvinyl alcohol was chosen as the most promising of several possible combinations for the die-pressing of beryllia. The optimum sintering condition for beryllia (UOX grade), die pressed with binder-lubricant at 7 ton/in.^{2}, to achieve a density greater than 2.86 g/cm^3, a grain size of less than 5 microns, and a strength greater than 30,000 lb/in.^{2}, may be close to 1 hour at 1500°C in dry nitrogen. Suggestions are made for improving the uniformity of the sintered material and for obtaining still finer grain sizes and higher strengths. (auth)

20503 THE PREPARATION AND CHARACTERISATION OF CERAMIC GRADE BERYLLIA. B. R. Steele, N. S. Hibbert, F. Rigby, R. Oldfield, and F. S. Martin

(United Kingdom Atomic Energy Authority, Springfields, Lancs, Eng). 16p. (CONF-281-7)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Preliminary investigations were made on the effects of powder preparation conditions on the sintering behavior of beryllia powders. Beryllium powder was produced by thermal decomposition of beryllium sulfate crystals that were prepared either by crystallization or by solvent extraction. Samples of sintered beryllia pellets were examined by optical and electron-microscopy. Sintered pellets from most of the powders show a rapid increase in grain size as the density increases above about 96% theoretical. Pellets prepared from a sample of beryllia purified by the solvent extraction route gave pellets of 97% theoretical density but with a grain size of only 3–4 μ. It is believed that rapid grain growth may be associated with the presence of some impurity in the beryllia. (P.C.H.)

20504 ON THE STUDY OF FABRICATION OF BeO–UO_2–Be FUEL PELLETS. S. Nishigaki and K. Maekawa (NGK Insulators Ltd., Nagoya, Japan). 26p. (CONF-281-34)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

In vacuum hot pressing of BeO–UO_2 containing 5–80 wt.% UO_2, the sinterability of the fuels was increased considerably by addition of 0.5–2 wt.% Be, that is, optimum sintering temperature range was extended to 100–200°C by addition of Be. Therefore, hot pressed BeO–UO_2 having density near the theoretical was readily obtained. The highly densified fuels were easily finished by using diamond wheel. The highest effectiveness of adding Be to BeO–UO_2 was the increase of mechanical strength equal to 1.5–2 times that of BeO–UO_2. For example, the maximum bending strength of BeO–5 wt.% UO_2–2 wt.% Be reached to 60000 psi, compared with 18600 psi of BeO–5 wt.% UO_2. Reasons for this are given. The increase of mechanical strength of BeO–UO_2 is considered, because the remaining Be diffuses homogeneously in the grain boundary of BeO and UO_2 and reinforces the mutual bonding between BeO and UO_2 grains. In fabricating fuel elements for practical use, the screened UO_2 particles of about 150μ will be dispersed in BeO matrix. On the other hand, in preliminary experiment, it was found that addition of a small amount of Be to BeO has the same effects as in the case of BeO–UO_2. Accordingly, it can be expected that addition of Be to BeO will restrain the irradiation damage of BeO at low irradiation temperatures, increases mechanical strength of BeO, and makes finishing of BeO easy. (P.C.H.)

20505 INVESTIGATION OF SINTERABLE BERYLLIUM OXIDE POWDERS TO OBTAIN SINTERS WITH REQUIRED PROPERTIES. P. Morize and J. Elston (Commissariat a l'Energie Atomique, Saclay, France). 36p. (CONF-281-8). (In French)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The preparation of BeO powders from beryllium hydroxide and sulfate was studied, together with the effects of atmosphere, composition, temperature, and speed and duration of heating. The most favorable conditions for sintering were found to be heating under vacuum above 1500°C of compressed forms composed of BeO powder containing <0.3% of SO_3 with crystallites with mean dimensions of 1000 to 3000 Å and with an apparent density >0.2. In a hydrogen atmosphere, the highest densities were obtained by rapid heating of powder prepared by calcination of beryllium sulfate. By varying the conditions affecting the result of the sintering, a given density, grain size, and (in some cases) localization of porosity can be obtained. (D.C.W.)

20506 IMPROVEMENTS RELATING TO FINNED METAL TUBING. Thomas Edwin Chapman (to Fairey Engineering Ltd.). British Patent 954,655. Apr. 8, 1964. Filed Oct. 21, 1960.

An externally finned metal tube for use as a reactor fuel can is designed which is comparatively easy to fabricate and results in a balanced gas-flow turbulence. The tube has a fin pattern comprising splitter fins extending in the longitudinal direction to define sectors, and heat exchange fins in each sector projecting laterally from the tube with their opposed faces parallel to one another and extending helically along the tube. The fins in each sector may be plane skew fins or a group of parallel V-shaped fins, and the plane of the fins may be arranged to bisect the angle between the splitter fins defining that sector. Since all the fins in any one sector are parallel to one another, the tube can be fabricated by a die-stamping operation. Several embodiments of the finned tube and tools for their fabrication are described. (D.L.C.)

20507 IMPROVEMENTS IN OR RELATING TO REACTOR FUELS. Lewis Eric Russell and John David Lawrence Harrison (to United Kingdom Atomic Energy Authority). British Patent 954,720. Apr. 8, 1964. Filed Apr. 2, 1962.

A process is given for producing uranium carbide fuel material enriched with plutonium, for use in fast reactors. The process comprises taking a powder of mixed uranium and plutonium carbides of size 2 to 4 μ, a carbon content of 48 to 53 at. % and an oxygen content below 1 wt %, compacting the powder into pellets, and sintering the pellets in an inert atmosphere. The inert atmosphere should be argon containing less than 10 ppm oxygen and 10 ppm water, and the sintering should be conducted at ~1550°C. The atomic ratio of plutonium to uranium is 15 to 85, and the carbon content is preferably 53 at. %. The process should be carried out rapidly so that no oxygen or water is introduced into the fuel. (D.L.C.)

20508 IMPROVEMENTS IN OR RELATING TO PROCESS FOR THE PREPARATION OF CARBIDE. Jim Woolford Isaacs and Michael Palfreyman (to United Kingdom Atomic Energy Authority). British Patent 954,821. Apr. 8, 1964. Filed Apr. 2, 1962.

A process is given for the production of a mixed PuC–UC alloy which may be used as fuel for fast reactors. The process comprises mixing together finely ground oxide-free U powder (<50 μ), ultra-fine graphite powder (<1 μ), and coarse PuC powder (250 to 425 μ), cold-compacting the mixture, and rapidly heating the mixture in a furnace to a temperature between 1000 and 1300°C. The heat of reaction of U with graphite causes the temperature of the compact to rise above 1125°C, so that sintering of the mixed carbides occurs. The furnace atmosphere is either vacuum or argon with less than 10 ppm oxygen. (D.L.C.)

20509 PROCESS AND APPARATUS FOR OBTAINING GRANULAR URANIUM DIOXIDE. (to Nuklear-Chemie and -Metallurgie GmbH). British Patent 954,868. Apr. 8, 1964. Priority date June 24, 1961, Germany.

A process and an apparatus are described for melting finely powdered UO_2 to obtain granular UO_2 which may be ground to a powder suitable for consolidation to high den-

sity in fuel elements. In the process, the fine powder is applied to a support and the surface layer is melted in an electric arc and then solidified to form granules. The arc is struck between tungsten electrodes in a H_2 atmosphere, and the support is a water-cooled copper disc. (D.L.C.)

20510 GRAPHITE COATING OF FUEL PARTICLES. (to High Temperature Materials Inc.). British Patent 955,462. Apr. 15, 1964. Priority date Jan. 22, 1962, United States.

A process is given for depositing pyrolytic graphite on particles of thorium and/or uranium oxide or carbide, to produce coated fuel particles which effectively retain fission products. In the method, the pyrolytic graphite is produced by the thermal decomposition of a hydrocarbon gas in the presence of the particles, at 1500 to 3000°C and 1 to 200 mm Hg. A graphite reactor for carrying out the process is described. Several examples of the process are given. The process is a modification of that described in British Patent 943,719. (D.L.C.)

20511 REFRACTORY ARTICLES AND METHODS OF MAKING SUCH REFRACTORY ARTICLES. (to Norton Co.). British Patent 955,629. Apr. 15, 1964. Priority date Mar. 7, 1961, United States.

A method is given for making graphite articles with an impervious refractory coating which gives protection against corrosion or oxidation at high temperatures, e.g. by CO_2. The coating consists of silicon carbide and a glaze of fused $ZnO-Al_2O_3-Pb_3O_4-SiO_2$ mixture covering the silicon carbide. The preferable composition of the glaze is 6 to 10% ZnO, 2 to 6% Al_2O_3, 25 to 30% SiO_2, and 55 to 65% Pb_3O_4. The method comprises applying a coating of a frit mixture over a SiC layer on a graphite body and firing the body at 1200 to 1300°C to fuse the frit mixture. An example of the method and the resulting improved oxidation resistance is given. (D.L.C.)

Properties and Structure

20512 (ASD-TDR-62-7(Pt.II)) RESEARCH TO DETERMINE COMPOSITION OF DISPERSED PHASES IN REFRACTORY METAL ALLOYS. PART II. CONCENTRATION GRADIENTS IN REFRACTORY METAL BINARY DIFFUSION COUPLES. Robert E. Ogilvie, Sheldon H. Moll, and Donald M. Koffman (Advanced Metals Research Corp., Sommerville, Mass.). Apr. 1963. Contract AF33(616)-7671. 98p.

The concentration gradients present in pure metal and alloy incremental, two-component, diffusion couples were determined by means of electron beam microanalysis. The binary systems studied included Nb–V, Cu–Pt, and Ta–Pt. Preparation of the diffusion couples and data reduction of the determined gradients are to be performed by computer techniques. In a parallel study the equilibrium chemistry of individual phases present in two-phase alloys of the Ta–Pt system was determined by means of electron beam microanalysis. These data aided the diffusion gradient study and a phase diagram study also carried out. The crystal structures, lattice parameters, and chemistries of dispersed phase precipitates in two Mo–TZC alloys (1.6 Ti–0.58 Zr–0.13 C) were determined. One alloy was as-extruded and the other as-swaged. The combined techniques of x-ray diffraction and electron beam microanalysis were employed. The phases were shown to be alloy carbides of the TiC and ZrC systems. (auth)

20513 (CNLM-4234) THE THERMAL EXPANSION OF FIVE TITANIUM CARBIDE CERMETS FROM 68 TO 1800F. L. C. Harrington and G. H. Rowe (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). [Aug. 17, 1962]. Contract [AT(30-1)-2789]. 30p.

Measurements are presented of the thermal expansion of five titanium carbide type cermets from 68 to 1800°F. These cermets are designated by Kennametal, Inc., as K 138A, K 150A, K 151A, K 152B, and K 162B. They contain from 64 to 80 weight percent titanium carbide, 10 to 30 weight percent metal binder, and 6 to 10 weight percent other carbides. The metal binders are cobalt, nickel, or nickel and molybdenum. An attempt was made to calculate the thermal expansion of each type cermet from the thermal expansions of the constituents. The expansion of the mixture was computed by weighting the expansions of the constituents according to (1) weight percent of the constituents, (2) volume percent of the constituents, and (3) according to a value developed for mixtures by P. S. Turner. It was found that expansions computed according to volume percent and by Turner's method agreed with measured values within ±5 percent. The values calculated by weight percent were from 5 to 11 percent higher than the observed values. The thermal expansions of these cermets are compared with the expansions of a group of metals and alloys. (auth)

20514 (CNLM-4479) THE THERMAL EXPANSION OF THIRTEEN TUNGSTEN CARBIDE CERMETS FROM 68 TO 1800 F. L. C. Harrington and G. H. Rowe (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). [Apr. 26, 1963]. Contract [AT(30-1)-2789]. 35p.

The linear thermal expansion of thirteen tungsten carbide cermets with cobalt binder was investigated experimentally over the temperature range from 68 to 1800°F. Cobalt contents varied from 2.5 to 60 per cent. Several compositions included additions of mixed carbides of titanium, tantalum, and columbium. The experimentally observed coefficients of thermal expansion for the various compositions were compared with coefficients analytically computed from the coefficients for the constituents. Three such analytical methods were evaluated. In one method, the coefficient of expansion of the mixture was computed by volume fractions and in a second method by weight fractions. In the third method, the computation accounted for the stresses set up in the mixture by the difference in thermal expansion of the carbide skeleton and the cobalt binder. The expansions of all these cermets agreed with the values computed by weight fractions or by the stress method within 12 per cent, and by volume fractions within 28 per cent. The cermets containing less than one per cent mixed carbides agreed with the expansion computed either by weight fractions or by stress within 8 per cent, the cermets containing more than five per cent mixed carbides agreed with values computed by volume fractions within 7 per cent. The thermal expansions of these cermets are compared with the expansion of some metals and alloys. (auth)

20515 (CONF-356-11) MECHANICAL PROPERTIES OF THIN FILMS. Technical Report No. 29. R. W. Hoffman (Case Inst. of Tech., Cleveland). Nov. 1963. Contract AT(11-1)-623. 74p.

From 1963 American Society of Metals/Metals and Materials Show, Cleveland, Oct. 1963, 23rd National Convention of the Society for Nondestructive Testing.

The elastic and plastic properties are reviewed with

special emphasis on metal films prepared by vacuum evaporation, although work with both non-metals and other preparation techniques is discussed when it is the only existing data or has particular importance. A definite lack of agreement exists among the various workers and as a result detailed explanations are not possible although general suggestions do exist. The structure of thick polycrystalline films is reviewed as it is important to a discussion of the mechanical properties, but the structure is in itself poorly understood in the case of thick films. The general behavior may be summarized as follows: The elastic modulus seems to be the same as that of bulk material. Breaking strengths are normally 3 to 7 times larger than those of annealed bulk material and compare with values for very heavily cold-worked samples. Creep is usually observed at relatively low strains. The increased strength undoubtedly arises from a restriction of dislocation motion, as well as source limitations, and in this respect differ from whiskers which often have a low dislocation concentration. The relative importance of pinning by point defects or impurities, limitations of dislocation length by the thickness or crystalline size, dislocation interactions and contributions from the oxide layer on the surface are not known. Although some of these should be thickness dependent, all experiments do not show such a trend. Fracture results from the motion of many dislocations leading to a localized thinning and ultimately cracks in the film. Separation of crystallite size and microstrain broadening of diffraction lines has been done in several cases. Stresses may result from differential thermal expansion as well as the film itself. The intrinsic stresses are often tensile, large, and depend strongly on the substrate temperature during deposition and somewhat less strongly on the rate at which the film is formed. Anisotropic stresses are found when the atoms arrive at other than normal incidence. The intrinsic stress may arise from a combination of surface tension and effects between the boundaries of the crystallites. (auth)

20516 (EUR-599.d) ZUR KENNTNIS DER PHYSIKALISCHEN STOFFEIGENSCHAFTEN VON FLUSSIGMETALLEN ZWISCHEN SCHMELZUND SIEDEPUNKT. (Physical Properties of Liquid Metals on the Region of Melting- and Boiling Point). K.-H. Spiller (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 60p.

Presented is the knowledge of the physical properties of some important liquid metals (sodium, potassium, NaK, Pb–Bi eutectic, and tin) in the temperature range between point of fusion and boiling point. This knowledge is taken from the numerous sources of literature referred. The data of different papers scattering essentially in part, the sources are critically viewed and on graphs those data are emphasized by a curve which seems to be the most reliable ones for the moment. A table gives a comparative survey on the properties of other metals too which are not especially treated. (auth)

20517 (EUR-1613.i) ANALISI DILATOMETRICA DEL S.A.P. A DIFFERENTI TENORI IN OSSIDO. (Dilatometric Analysis of S.A.P. with Various Oxide Contents). G. Beghi, G. Piatti, and D. Quataert (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1964. 24p. (CONF-425-2)

From the Conference on Nonfissile Metals for Nuclear Reactors, Bologna, Dec. 1963.

The average linear thermal expansion coefficient of SAP with various oxide contents was experimentally determined for the temperature ranges 20–100, 20–200, 20–300, 20–400, and 20–500°C. Equations for the length of SAP 960, 930, 895, and 865 as a function of temperature were obtained from the experimental data. In addition, a scheme for the theoretical interpretation of the results is proposed which involves the hypothesis of cohesive forces existing in the SAP between oxide particles and the aluminium matrix. (auth)

20518 (HW-74949) QUANTITATIVE METALLOGRAPHY OF HYDRIDE PHASE IN ZIRCALOY-2 PROCESS TUBES. L. A. Hartcorn and R. E. Westerman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1963. Contract AT(45-1-)1350. 21p.

The advantages and disadvantages of metallographic estimation of the amount of hydride present in a Zr alloy are outlined. A set of standard micrographs are presented for the quantitative estimation of hydrogen in Zircaloy-2 process tubes. The standard samples were charged with controlled amounts of hydrogen (15 to 810 ppm H) and micrographs were made of transverse, longitudinal, and planar sections. (D.L.C.)

20519 (IS-551) MAGNETIC PROPERTIES OF SOME INTRA-RARE EARTH ALLOYS. P. E. Roughan and A. H. Daane (Ames Lab., Ames, Iowa). [Sept. 18, 1962]. Contract W-7405-eng-82. 23p.

Paramagnetic susceptibilities of samarium structure alloys in the systems La–Gd, Nd–Y, Nd–Tm, and Ce–Y were measured from 4.2 to 300°K to determine what effect the formation of this structure had on the magnetic properties of the alloys. Susceptibility maxima were observed in the Nd–Y and Nd–Tm alloys, at 34.5 and 28.5°K, respectively. Slope changes were observed in the curve of $1/\chi$ versus T for the La–Gd alloy at 155 and 130°K, and the susceptibility of this alloy remained temperature-independent from 130 to 7°K. A rather poorly defined region of constant susceptibility was also observed for the Ce–Y alloy, from 26 to 37°K. Above these transition temperatures, the alloys obeyed the Curie-Weiss law, the susceptibilities of the La–Gd and Ce–Y samples indicating the possibility of electron transfer occurring in these cases. (auth)

20520 (IS-841) THE Y–Nd AND Sc–Nd PHASE SYSTEMS. B. J. Beaudry, M. Michel, A. H. Daane, and F. H. Spedding (Ames Lab., Ames, Iowa). Feb. 1964. Contract W-7405-eng-82. 18p. (CONF-405-7)

From 4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964.

The occurrence of an intermediate (delta) phase with the structure of Sm in alloys of a heavy rare earth with a light rare earth are discussed. Studies were made using thermal, x-ray, and metallographic methods of the Sc–Nd and Y–Nd phase diagrams. The Y–Nd system was found to contain a delta phase at 62 to 69 at.% Nd. The absence of a two-phase region above 700°C in the Sc–Nd system indicates a continuous change in symmetry in going from Sc to Nd. The prediction of the composition of the delta phase in several alloy systems is discussed. (D.L.C.)

20521 (KAPL-3016) EFFECT OF 1.0% MEAN STRAIN ON THE BENDING-FATIGUE PROPERTIES OF ZIRCALOY-4. D. F. Mowbray (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 23, 1964. Contract W-31-109-eng-52. 32p.

The effect of 1.0% superimposed mean strain on constant-deflection cycled bending-fatigue specimens of wrought Zircaloy-4 was investigated. The investigation was confined mainly to the cyclic-life region of 10^5 to 10^6 cycles, and to two temperatures–room temperature

and 600°F. Also, a limited investigation was conducted to determine the effects of oxide films on fatigue strength. The results indicated that 1.0% superimposed mean strain reduces the fatigue strength at both room temperature and 600°F, and that an oxide film formed by exposure to 680°F water for 72 hr is detrimental to fatigue strength at room temperature. (auth)

20522 (LADC-5788) THE THERMAL EXPANSION OF PuC AND UC–PuC SOLID SOLUTION. A. E. Ogard, C. C. Land, and J. A. Leary (Los Alamos Scientific Lab., N. Mex.). Mar. 12, 1963. Contract [W-7405-eng-36]. 18p.

For additional details see report LA-2768.

Thermal expansion characteristics for arc melted plutonium-carbon alloys containing 41.1, 43.2, 44.9, 45.4, 45.8 at. % carbon and for $U_{0.87}Pu_{0.13}C$ have been determined between room temperature and 900°C. The average coefficients of linear thermal expansion for a single phase alloy containing 45.8 at. % carbon and for single phase $U_{0.87}Pu_{0.13}C$ are presented as well as results pertaining to the plutonium-carbon phase diagram. A mechanism has been suggested to explain the unusual contraction that was observed in the dilatometric curves for the alloys that contained 43.2, 44.9, and 45.4 at. % carbon. (auth)

20523 (NP-13811) DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS II. Bimonthly Report No. 5, November 1, 1963 through January 1, 1964. D. B. Warmuth (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Feb. 1, 1964. Contract NOw-63-0471c. 60p. (TM-3866-67)

The major part of the mechanical property tests on Pfaudler and TRW coated 30 mil B-66 and D-43 niobium alloy sheet was completed. The results of tensile tests conducted on coated sheet at room temperature to 2600°F are reported and compared with properties of uncoated sheet. A limited study of the effect of different tensile strain rates at 2300–2600°F is discussed. Results of creep tests conducted on the coated B-66 and D-43 alloy sheet are reported. These data pertain to tests run at 1600, 2000, 2300, and 2600°F in air. Preliminary results of coating deformation tolerance tests at room temperature, 400, and 800°F are presented. (auth)

20524 (ORNL-3608) A STUDY OF THE RESPONSE CONTOURS OF THE HOT-PRESSED DENSITY OF THORIUM OXIDE PELLETS. Donald A. Gardiner (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 19p.

Hot-pressed density of ThO_2 pellets as a function of time, temperature, and load may be approximated adequately by the quadratic function: $Y_c = 6.439 + 0.165\ x_1 + 0.890\ x_2 + 0.314\ x_3 - 0.0306\ x_1^2 + 0.138\ x_2^2 + 0.0482\ x_3^2 + 0.0025\ x_1 x_2 + 0.0425\ x_1 x_3 + 0.195\ x_2 x_3 + 0.260\ z$ in which Y_c is predicted density, x_1, x_2, and x_3 represent transformed time, temperature, and load and $z = -0.4$ or $+0.6$ as the ThO_2 is representative of batch Th-3D or batch Th-3B of powder. The equation is useful only for times between 20 and 900 seconds, temperatures between 1,000 and 1,600°C, and loads between 0 and 3,000 psi. Any attempt to use this equation beyond these ranges would not be recommended. However, within these ranges of the independent variables, the final hot-pressed density may be predicted within adequate limits of error. (auth)

20525 (R63SD89) AEROTHERMOCHEMICAL BEHAVIOR OF GRAPHITE AT ELEVATED TEMPERATURES. S. M. Scala and L. M. Gilbert (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Nov. 1963. 29p. (AD-432594)

Presented are the results of a unified theoretical treatment of the graphite ablation process (including heat and mass transfer correlation equations) over the entire range of pressures and surface temperatures of interest (i.e. from room temperature up to 10,000°F). (auth)

20526 (RADC-TDR-63-269) FAILURE MECHANISMS IN CERAMIC DIELECTRICS. Final Report. Don A. Berlincourt (Clevite Corp., Cleveland). Apr. 30, 1963. Contract AF30(602)-2594. 112p. (AD-414353)

With the objective of developing an empirical approach to factors influencing failure in ceramics of high dielectric constant (greater than ~200), a number of perovskite (ABO_3) dielectrics were prepared and studied. Small substitutions of Nb^{5+} for the B^{4+} ion (Ti^{4+},Zr^{4+}) and of Sc^{3+} for the A ion (Pb^{2+}, Ba^{2+}, Sr^{2+}) were made. Nb^{5+} and Sc^{3+} thus act, respectively, as electron donor and acceptor. It was demonstrated that the zirconates, as a class, are far superior to the titanates with respect to long term degradation, which is probably best ascribed to electrolysis of oxygen. This can proceed more rapidly with the titanates, since Ti^{4+} is much more readily reduced than is Zr^{4+}. In general, also, the zirconates have higher volume resistivities than the titanates, but there is no clear-cut difference in dielectric strength. Degradation in dielectrics with p-type conduction, which was found to be the usual case, is generally inhibited by donor doping. (auth)

20527 (RFP-351) EXPERIMENTS USING THE THERMOELECTRIC EMF OF A Pu-1 w/o Ga ALLOY. R. H. Karlsson (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Feb. 3, 1964. Contract AT(29-1)-1106. 8p.

Experiments were conducted using a plutonium-1 wt.% gallium alloy (δ Pu) as a thermocouple material in conjunction with chromel and constantan to determine whether a difference of sufficient magnitude in thermoelectric power existed between the plutonium alloy δ and ϵ phases to allow $\delta \rightleftharpoons \epsilon$ phase transformation kinetics to be measured thermoelectrically. It was concluded that if a difference in thermoelectric power did exist between the two phases, it was too small to permit thermoelectric phase transformation measurements. The thermoelectric power of δ plutonium was determined relative to chromel and constantan for selected temperature ranges. Experimental and handbook data were combined to give an approximation of the absolute thermoelectric power of δ plutonium at 327°C. (auth)

20528 (SWRI-1228-18) EVALUATION OF THE SERVICEABILITY OF THE ELK RIVER REACTOR PRESSURE VESSEL. Progress Report No. 3, October 1–November 30, 1963. Robert D. Wylie (Southwest Research Inst., San Antonio). Mar. 31, 1964. Contract AT(11-1)-1228. 8p.

A research program is being conducted to determine the effects of fabrication history, dissimilar weld metallurgy and geometry, and irradiation on the nil-ductility transition temperature and fatigue properties of A105 Grade II and A302 Grade B steels. Results are reported of fatigue tests conducted at stresses below and equal to the yield strength of A302 B steel strained at ambient temperature and stress relieved. Shell-forming operations were found to improve the 30 ft-lb nil-ductility transition temperature of as-received A302 B steel, and notch ductility characteristic data are given for as-received A302 B steel. Weldments

which simulate the nozzle-to-end cap dissimilar welds of the ERR pressure vessel were radiographed and found to be free of defects. The possibility of in-pile fatigue tests and ultrasonic nondestructive testing for gross defects in critical areas of the ERR pressure vessel are considered. (D.L.C.)

20529 (TID-20463) A FURTHER STUDY OF THE WELD HEAT-AFFECTED ZONE IN A-212-B STEEL. Combined Final Report. Warren F. Savage and Fred C. Breismeister (Rensselaer Polytechnic Inst., Troy, N. Y.). Jan. 1964. For Oak Ridge National Lab., Tenn. Contract [W-7405-eng-26], Subcontracts 2209 and 2172. 90p.

Materials being used for the first time in the Experimental Gas Cooled Reactor deserve careful evaluation. The effect of welding fabrication and irradiation on the serviceability of A-212-B steel for the containment vessel are therefore being evaluated. As part of this evaluation program, the RPI synthetic specimen technique has been employed to provide specimens containing selected microstructures characteristic of the weld heat-affected zone in A-212-B for exposure to both accelerated irradiation and long term irradiation in the actual reactor. A three-part investigation was started, the purpose being: (1) To measure weld thermal cycles associated with the fabrication of the containment vessel. (2) To select two representative weld thermal cycles likely to cause the most severe impairment of notch toughness and use them to duplicate corresponding portions of the weld heat-affected zone in synthetic specimens. (3) To test samples of each of the resulting microstructures in impact, thus providing bases for evaluation of the effects of irradiation. Weld thermal cycles were measured using welding conditions similar to those used in the construction of the containment vessel and employed to reproduce the grain coarsened microstructures of the heat-affected zone in two of the steels used in the actual vessel. These specimens showed a significant difference between the two heats of steel studied when subjected to the same weld thermal cycle. The observed differences in microstructure were subsequently related to the results of impact tests. Heat No. 2110 was found to be superior to Heat No. 2056 in the As-Received condition, the As-Welded condition, and the welded-plus-stress-relieved condition. The notch toughness of both heats of steel was severely impaired in the as welded condition, and although Heat No. 2110 showed improved notch toughness after stress relief, Heat No. 2056 did not respond to stress relief. The thermal cycle studied with the slower cooling rate was more detrimental than the thermal cycle having the faster cooling rate in both heats of steel. Heat No. 2110, because it produced more low temperature products, responded to stress relief as a consequence of the tempering action. Heat No. 2056, which showed more elevated temperature transformation products, was not significantly altered by stress relief, did not improve significantly in notch toughness as a result of subsequent stress relief. (auth)

20530 (UCRL-6894(Rev.II)) THERMAL CONDUCTIVITY OF ROCK SALT. D. R. Stephens and A. Maimoni (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 1, 1964. Contract W-7405-eng-48. 15p.

The thermal conductivity of rock salt from the Carey Mine (Winfield, La.), was measured to 900°K. The data fit the following equation with a probable error of ±3.5%: $k = 3.4/(T - 100) + 8.5 \times 10^{-12}T^3$ for $400°K \leq T \leq 900°K$, where k = thermal conductivity, cal/(sec)(°K)(cm) and T = temperature, °K. (auth)

20531 (UCRL-7255) VISCOELASTICITY OF POLYMERS. Maurice Zaslawsky (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 26, 1963. Contract W-7405-eng-48. 49p.

A review of the state of the art of viscoelasticity from the applied mechanics standpoint is presented. Both linear and nonlinear viscoelasticity is discussed with reference to both the theoretical and experimental aspects. A simple design problem is used as an example and extensions of the problem are discussed. The experimental approach of the Combined Stress Viscoelastic Project at Lawrence Radiation Laboratory is presented. (auth)

20532 (UCRL-7381-T) PREFERRED ORIENTATION OF POLYCRYSTALLINE BeO. J. S. Kahn (California. Univ., Livermore. Lawrence Radiation Lab.). May 14, 1963. Contract [W-7405-eng-48]. 6p.

A study was conducted to determine when the development of preferred orientation in extruded, sintered polycrystalline BeO takes place. A series of BeO hexagonal tubes subjected to different sintering temperatures and times was analyzed by x-ray diffraction just after extrusion, after drying, after starch burning, and after sintering. The results indicate that the BeO is preferentially orientated when it is extruded, and that this orientation becomes more marked with sintering temperature and time. (D.L.C.)

20533 (UCRL-10728) ON THE ROLE OF DISLOCATIONS IN THE RECOVERY OF COLD-WORKED ALUMINUM. Abraham Rosen and John E. Dorn (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 2, 1963. Contract W-7405-eng-48. 31p.

The recovery of cold worked aluminum under stress was investigated by means of measurements of the mean distance between points of intersection on a dislocation line and the athermal resistance to the motion of the dislocation. The activation energy for recovery is constant, regardless of stress, temperature and extent of recovery, and suggests that the rate of recovery is controlled by the rate of intersection of dislocations. (auth)

20534 (UCRL-11166) LIQUID-SOLID TRANSFORMATION KINETICS IN Al_2O_3. Amio R. Das and Richard M. Fulrath (California. Univ., Berkeley. Lawrence Radiation Lab.). Dec. 26, 1963. Contract W-7405-eng-48. 26p. (CONF-489-1)

For Presentation at 5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964.

A d-c arc plasma torch was used to subject sized particles of synthetic sapphire in the range of 9 to 104 microns to rapid melting and resolidification. In order to study the formation of metastable phases of alumina, the size and apparent density of spheroidized particles were used as parameters in determining quenching rates. A hypothesis based on the kinetics of nucleation of the crystalline solid phases from the supercooled liquid droplets is proposed to explain the ratio of the metastable phases to the stable α phase. Experimental data relating this ratio with quench rates of the liquid droplets are presented. (auth)

20535 (Y-1455) EFFECT OF EXPLOSIVE IMPACTING ON URANIUM. R. B. Burditt, W. T. Carey, and C. P. Coughlen (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). June 17, 1963. Contract W-7405-eng-26. 86p.

The tensile and yield strengths of both cast and wrought uranium discs were substantially increased by explosively impacting them at room temperature and at 375°F. However, the room-temperature impacting caused gross dam-

age in the cast material and slight internal damage in the wrought material at the highest impacting pressures. Impacting at 375°F, which is just above the brittle-ductile transition temperature for uranium, was the most effective method for increasing the strengths with no damage to either the cast or wrought material. This impacted material retained some of its increased strength after a low-temperature (425°C) vacuum anneal that greatly increased the elongation. A salt anneal caused a partial recrystallization in the impacted cast uranium. (auth)

20536 (AEC-tr-6313) SOLID STATE DIFFUSION IN METALS AND ALLOYS. S. D. Gertsriken and I. Ya. Dekhtyar. Translated from a publication of the State Publishing House for Physical-Mathematical Literature, Moscow, 1960. 538p.

A book is presented on diffusion in metals and alloys and its relationship to other properties. The chapters treat the diffusion laws and formulas, diffusion theory, methods of investigating diffusion in metals (including radioisotope methods), interatomic interaction in alloys, defects in crystal structure, heat resistance, and protective coatings. An extensive bibliography is included. (D.L.C.)

20537 (EURAEC-977) STUDY OF THE MARTENSITE MESH PARAMETER. Special Report No. 16, January 1, 1963–March 31, 1963. (Societe des Forges et Ateliers du Creusot, Paris). Work Performed under United States–Euratom Joint Research and Development Program. Contract 073-61-12-RDF. 28p. (A translation)

The nature and crystal structure of martensites are studied in terms of the influence of carbon content, alloying effects, and refining element effects. The study consists of a review of literature and experimental testing. (N.W.R.)

20538 STUDY OF THE RELATIONS BETWEEN PHASES IN THE SYSTEM La_2O_3–CaO–ZrO_2. Nora Schromek (Università, Trieste, Italy). Ann. Chim. (Rome), 53: 1560-73(Nov. 1963). (In Italian)

Finely ground mixtures of La_2O_3, $CaCO_3$, and ZrO_2 were heated in air 6 hr at 1600 ± 20°C or at 1400 ± 20°C for a week. The samples were studied by reflection microscopy and with x-ray diffraction powder diagrams, with the precaution to exclude moisture. A ternary compound of the composition $4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$ was found. At 1600°C the ternary diagram shows 4 ternary solid solutions: tetragonal ZrO_2; cubic ZrO_2; $La_2O_3 \cdot 2ZrO_2$; and La_2O_3. There are 9 pseudobinary regions: $La_2O_3 \cdot 2ZrO_2$–ZrO_2(tetr); ZrO_2(tetr)–ZrO_2(cub); $La_2O_3 \cdot 2ZrO_2$–ZrO_2(cub); ZrO_2(cub)–$CaZrO_3$; $La_2O_3 \cdot 2ZrO_2$–$4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$; La_2O_3–$La_2O_3 \cdot 2ZrO_2$; La_2O_3–$4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$; La_2O_3–CaO; $4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$–CaO. There are 4 ternary regions: $La_2O_3 \cdot 2ZrO_2$–ZrO_2(tetr)–ZrO_2(cub); $La_2O_3 \cdot 2ZrO_2$–ZrO_2(cub)–$CaZrO_3$; La_2O_3–$La_2O_3 \cdot 2ZrO_2$–$4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$; La_2O_3–$4La_2O_3 \cdot 5CaO \cdot 5ZrO_2$–CaO. Samples heated to 1400°C show regions of solid solutions with appreciable differences. The regions of solubility appear to be considerably restricted at this temperature. (BBB)

20539 HEAT CONDUCTION BY NUCLEAR GRAPHITE. M. Bocquet and G. Micaud. Bull. Inform. Sci. Tech. (Paris), No. 79, 83-96(Jan. 1964). (In French)

Two methods for measuring the coefficient of thermal conductivity of graphite are described, together with the measurement apparatus developed for each method. The results of an investigation of the effects of crystalline anisotropy, apparent density, the type of coke used, temperature, and irradiation on the coefficient are presented. (D.C.W.)

20540 ON THE REACTIVE DIFFUSION OF BORON AND CARBON IN REFRACTORY TRANSITION METALS. G. V. Samsonov (Inst. of Metal Ceramics and Special Alloys, Academy of Sciences, Ukranian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 1, 68-70(1964). (In Ukrainian)

An investigation was made on the effect of the conditions of boration and carbidization of titanium, zirconium, niobium, tantalum, molybdenum, and tungsten on the structure, phase composition, and thickness of diffusive carbide and boride coatings. The parameters of the diffusion of boron and carbon in the enumerated metals are determined by the results of metallographic, x-ray, and chemical investigations, as well as measurements of the thickness and microhardness of the diffusion layers. The previously established dependence between the criterion of acceptor capacity of the d-electron shell of metal atoms $1/N_n$ (n is the number of electrons on the d-shell, N is the principal quantum number) and the magnitude of energy activation is confirmed. (auth)

20541 MAGNETIC SUSCEPTIBILITY OF SILICIDES OF SEVERAL CONDUCTING METALS. V. S. Neshpor, S. N. Lvov, and G. V. Samsonov (Inst. of Metalloceramics and Special Alloys, Academy of Sciences, Ukrainian SSR and Kherson Pedagogical Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 160-3(1964). (In Russian)

The magnetic susceptibilities of the silicides of titanium, chromium, zirconium, niobium, tantalum, and molybdenum are investigated. (C.E.S.)

20542 A PHYSICOCHEMICAL TECHNIQUE FOR EVALUATING DEFECTS IN GRAPHITE. I. L. Spain, A. R. Ubbelohde, and D. A. Young (Imperial Coll. of Science and Tech., London). J. Chem. Soc.: 920-7(Mar. 1964).

Threshold values of chemical potential are found, below which even well-oriented graphites fail to form crystal compounds by intercalation of iodine monochloride or bromine. Such thresholds, measured by a titration method in which the end-point is determined by changes of electrical resistance, were correlated with other data on defect structures in pyrolytic graphite. The defect concentrations were varied by adjusting the conditions of pyrolysis and heat treatment. Defects were also introduced into some samples by fast-neutron bombardment, and the annealing behavior of such defects was correlated with the progressive displacement of the intercalation thresholds. The mechanisms operate at the onset of intercalation are discussed in the light of these findings. (auth)

20543 DEFORMATION MECHANISMS IN NIOBIUM. A. Fourdeux and A. Wronski (Union Carbide European Research Associates, Brussels). Mem. Sci. Rev. Met., 61: 185-90(Mar. 1964). (In French)

Flash-annealed and conventionally vacuum (10^{-6} Torr) annealed niobium foils were deformed at 295 and 77°K and their dislocation structure studied by transmission electron microscopy. The results are discussed in terms of a model in which yielding results from the dislocation multiplication and velocity characteristics. (auth)

20544 HARDNESS AND ANNEALING BEHAVIOR OF UO_2. Toraji Nishijima and Toshiyuki Kawada (Tokyo Shibaura Electric Co., Ltd.). Nippon Genshiryoku Gakkaishi, 6: 154-8(Mar. 1964). (In Japanese)

The behavior of sintered UO_2 pellets (96.0% T.D.) at elevated temperature was investigated. Hardness was

neasured in the temperature range from −180 to 800°C. With increasing temperature hardness of UO_2 decreased rapidly at the lower temperature range and slowly in the temperature range above 200 ~ 300°C. For comparison, hardness of several kinds of metal was measured under the same condition as UO_2, among which tungsten showed similar temperature dependence of hardness with UO_2. Microscopic observation was done around the indentation caused by the diamond pyramid indenter of the Vickers hardness tester. It was found that the number of cracks in the specimen indented decreased gradually with increasing temperature and disappeared completely in the specimens indented above 500°C. Specimens were annealed in hydrogen atmosphere after indented at various temperatures. No change was observed in the specimens indented at relatively low temperatures. However, in the specimens indented at temperatures above 400°C, abnormal grain growth was observed around the indentation after annealing at 1700°C. The experimental facts are discussed, and it was concluded that they are due to the plastic nature of UO_2. (auth)

20545 ALLOTROPIC TRANSFORMATION CHARACTERISTICS OF TITANIUM ALLOYS DURING CONTINUOUS COOLING. Hideo Kaneko and Y. C. Huang. Nippon Kinzoku Gakkaishi, 27: 387-93(1963). (In Japanese)

Continuous cooling transformation diagrams of five kinds of titanium-base binary alloys, Ti−Mo, Ti−V, Ti−Nb, Ti−Al, and Ti−Sn are summarized. The specimens were soaked at a suitable temperature under an argon protective atmosphere, prior to quenching, which was carried out by argon jet stream. Cooling curves were automatically drawn by recording temperature changes by an electromagnetic oscillograph. From the cooling curves, the continuous cooling transformation diagram was constructed for the respective titanium alloys. (P.C.H.)

20546 ON THE DETERMINATION OF THE NATURE OF DISLOCATION LOOPS. B. Edmondson and G. K. Williamson (Central Electricity Generating Board, London). Phil. Mag. (8), 9: 277-83(Feb. 1964).

A simplication of the electron microscope method for determination of the nature of dislocation loops is described. Full determination of the relevant diffraction conditions and of the Burgers vectors of the loops are avoided and knowledge of the sense of inclination of the loops and of the rotations of image and diffraction pattern is not required. An example is given of the application of the method. (auth)

20547 THE ELASTIC ENERGY OF A RHOMBUS-SHAPED DISLOCATION LOOP. R. Bullough and A. J. E. Foreman (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 315-29(Feb. 1964).

The elastic strain energy of a rhombus-shaped dislocation loop is calculated for an arbitrary rotation about the minor or major diagonal axis. For loops less than about one micron in size and constrained to move on the glide prism a shallow minimum in the energy exists displaced from the pure edge loop orientation. The depth of the minimum and its displacement from the pure edge orientation increase as the loop size decreases. The results provide an explanation for the observation by Makin and Hudson (1963) of such loops lying in {012} planes rather than in the {011} plane normal to the Burgers vector. The importance of the work done by the dislocation core tractions is emphasized and in particular its dependence on the method adopted for formally generating the dislocation loop. The misorientation effect is enhanced if the loop becomes extended into a pair of partials with a ribbon of stacking fault. An estimate of the core energy on the basis of an extended Peierls model does not preclude the effect. (auth)

20548 A NEW METHOD FOR THE ELECTRONIC STRUCTURE OF METALS. V. Heine and I. Abarenkov (Cambridge Univ., Eng.). Phil. Mag. (8), 9: 451-65(Mar. 1964).

A new method is described for setting up the effective potential for electrons in non-transition metals, including liquid metals and alloys. It is based on a model potential fitted to the spectroscopically measured energy levels of the free ions. The potential between the atomic cores is obtained from the dielectric screening calculation of Cohen and Phillips (1961) with some refinements. The method is tested on the band structures of the (solid) alkali metals. The Fermi surfaces of K, Rb, and Cs are found to be considerably less distorted than calculated by Ham (1962), and thus in better agreement with experiment. (auth)

20549 THE PHASE DIAGRAM OF THE ALUMINUM−MOLYBDENUM SYSTEM. L. K. Walford (Cambridge Univ., Eng.). Phil. Mag. (8), 9: 513-16(Mar. 1964).

Some changes to the aluminum-rich end of the Al−Mo phase diagram are proposed. The results of several workers indicate that two new phases ($MoAl_4$ and $MoAl_8$) have to be introduced and that one phase ($MoAl_2$) should be omitted from the existing diagram. (auth)

20550 A DETERMINATION OF THE STACKING-FAULT ENERGY OF SOME PURE F.C.C. METALS. I. L. Dillamore, R. E. Smallman, and W. T. Roberts (Univ. of Birmingham, Eng.). Phil. Mag. (8), 9: 517-26(Mar. 1964).

A method for determining the stacking-fault energy of f.c.c. materials has been developed using an already-established dependence of preferred orientation on stacking-fault energy. An empirically determined parameter, characteristic of the type of rolling texture exhibited by the metal, is related to the stacking-fault energy value obtained by measurements of dislocation node radius, and from the γ value for the three metals, Ag, Cu, and Ni the stacking-fault energy of Th, Au, Pd, Rh, Pt, and Yb has been obtained by interpolation using measured values of the texture parameter. (auth)

20551 X-RAY DIFFRACTION EVIDENCE FOR A CRITICAL END POINT FOR CERIUM I AND CERIUM II. Briant L. Davis and Leason H. Adams (Univ. of California, Los Angeles). Phys. Chem. Solids, 25: 379-88(Apr. 1964).

A beryllium pressure vessel was used to investigate the two face-centered phases of cerium at various temperatures and pressures along the phase boundary. X-ray diffraction records of the strong 111 peak of both phases show that the two peaks coalesce with increasing temperature and pressure along the boundary. The P-t region for the critical end point of the boundary is obtained by extrapolation of the change in d-spacing with distance along the boundary, and is found to be 350−400°C and 20−22 kb. The x-ray data also show that the compressibility and thermal expansion of the high-pressure (II) phase are greater than those of the low-pressure (I) phase. Rate studies indicate that under pressure phase I persists into the phase II stability field with lowering temperature. Considerable overstepping of pressure into this field is also possible before complete transformation of I-II will take place. (auth)

20552 POSITRON ANNIHILATION IN RARE-EARTH METALS. D. R. Gustafson and A. R. Mackintosh (Ames

Lab., Ames, Iowa). Phys. Chem. Solids, 25: 389-94(Apr. 1964).. (IS-616)

The electronic structure of three rare-earth metals was studied by measuring the angular correlations of the photons emitted when positrons annihilate with the electrons in the metal. From the results it was deduced that gadolinium and cerium at room temperature each has approximately three conduction electrons per atom, while ytterbium has approximately two as expected from the localized f-electron model. Qualitative information was obtained about the distortion of the Fermi surfaces of the three metals and it was concluded that the polarization of the conduction electrons in the magnetically ordered state of gadolinium is small. Annihilations with ion core electrons comprise a significant proportion of the total in each metal, the number relative to the conduction electron annihilations decreasing with increasing atomic number. (auth)

20553 THE COMPRESSION OF SOME RARE EARTH ELEMENTS. D. R. Stephens (Univ. of California, Livermore). Phys. Chem. Solids, 25: 423-9(Apr. 1964). (UCRL-7480).

The compression ($\Delta V/V_0$) of Pr, Eu, Tb, Yb, and Sc was measured to 45 kbars at room temperature. The phase transformation in Yb reported by others was determined to occur at 39.5 ± 0.5 kbar with a volume change of 1.2 ± 0.1%. (auth)

20554 THE $ThAl_2$–$ThMn_2$ SYSTEM. J. H. Wernick and R. R. Soden (Bell Telephone Labs. Inc., Murray Hill, N. J.). Phys. Chem. Solids, 25: 449-50(Apr. 1964).

Evidence of the close relation between the AlB_2 structure-type to the Laves phases of the actinide elements is presented. It is shown that $ThAl_2$ forms with $ThMn_2$ a true ternary Laves phase with the $MgCu_2$ structure type. The extent of the composition range of stability at 25°C is illustrated. Little terminal solid solubility exists in the pseudo-binary system contrast to the $ThAl_2$-UAl_2 system. An electron transfer mechanism, which effectively increases the size of Al and decreases the size of Th in $ThAl_2$, is suggested for the formation of the cubic Laves structure. (P.C.H.)

20555 INCOHERENT AND THERMAL SMALL-ANGLE X-RAY SCATTERING IN SILICON. D. L. Weinberg (Corning Glass Works, Corning, N. Y.). Phys. Rev., 134: A1016-18(May 18, 1964).

The intensity of small-angle x-ray scattering in single-crystal silicon was measured with the scattering vector K oriented along each of the three symmetry directions. The scattering intensity extrapolates to zero angle in reasonable agreement with the thermal scattering, calculated from the velocity of sound in each direction. The thermal scattering is calculated from known phonon dispersion relations and subtracted from the total to obtain the incoherent, or Compton, scattering. The incoherent scattering is smaller than that calculated by Freeman from Hartree-Fock wave functions for the free atom. This conclusion agrees with previous approximate measurements at small K on other crystals. Theoretical ideas about the source of the deficiency, apparently a solid-state effect, and about small-angle thermal scattering are outlined. The incoherent scattering shows little anisotropy and no sharp rise with increasing angle, which would suggest the onset of excitation of electrons across the forbidden band. (auth)

20556 ITINERANT ELECTRON FERROMAGNETISM IN $ZrZn_2$. S. J. Pickart (Naval Ordnance Lab., Silver Spring, Md. and Brookhaven National Lab., Upton, N. Y.), H. A. Alperin, G. Shirane, and R. Nathans. Phys. Rev. Letters, 12: 444-7(Apr. 20, 1964). (BNL-7893)

A large degree of nonlocalization of the zirconium spin density was observed in ferromagnetic $ZrZn_2$ by polarized neutron scattering. Comparison with free-atom 4d electron configurations suggests that the conduction band contributes significantly to the ferromagnetism. Thus, an itinerant electron model is indicated. (M.J.T.)

20557 STRUCTURE AND ELECTRONIC PROPERTIES OF NIOBIUM–RUTHENIUM ALLOYS. D. Bender, E. Bucher, and J. Mueller (Technische Hochschule, Zurich). Physik Kondensierten Materie, 1: 225-31(1963).

The electronic specific heat, the Debye temperature, the paramagnetic susceptibility, and the superconducting transition temperature were measured in the niobium-rich region of the Nb–Ru system. Structural investigation proved that the single phase region extends up to at least 45 at.% Ru at low temperatures, with a gradually increasing tetragonal deformation above 37% Ru. The results revealed a flat minimum in the density of states near a concentration of 5.7 valence electrons per atom. Comparison of specific heat and susceptibility data lent support to the suggestion that a van Vleck type paramagnetic contribution might be important in this and related alloy systems. The superconducting transition temperature of very pure niobium was found to be 9.49°K. (auth)

20558 MATERIALS FOR NUCLEAR REACTOR TECHNOLOGY. J. P. Hugo (South African Atomic Energy Board, Pretoria). S. African Ind. Chemist, 16: 182-9(Jan. 1962).

The most important metallurgical, physical, mechanical, and chemical properties of fuels and other reactor materials that determine their behavior in reactors and influence their fabrication into reactor components are discussed. (R.E.U.)

20559 INTERNAL FRICTION DUE TO DISLOCATIONS IN MOLYBDENUM AT KILOCYCLE FREQUENCY. Yehning Wang, Sui-din Ting, Shou-sheng Jiang, and Shih-yuan Wang (Nanking Univ., China). Sci. Sinica (Peking), 13: 517-19(Mar. 1964).

Internal friction as a function of strain amplitude in zone-refined single-crystal and polycrystalline Mo was measured by the three-component piezoelectric resonator method. A Granato-Lücke type of amplitude-dependent decrement was obtained in Mo single crystals annealed in hydrogen. (C.E.S.)

20560 DAMPING OF ELASTIC OSCILLATIONS IN Cu–Be AND Cu–In ALLOYS IN PHASE TRANSITIONS. I. G. Polotskii and M. S. Mordyuk (Inst. of Metal Physics, Kiev). Ukr. Fiz. Zh., 8: 1239-40(1963). (In Ukrainian)

The results are presented of an investigation of the effect of temperature and the time on the damping of elastic oscillations of varying frequency in Cu–Be and Cu–In alloys in phase transitions. It is shown that the internal friction peaks, observed in the investigated temperature region of aging of Cu–Be and Cu–In alloys are caused by phase transitions, and not by thermal conductivity or any other sources. The appearance of peaks on the time dependence curves of the damping decrement is due to disturbance of the conditions of phase equilibrium when the elastic wave passes through a mixture of two phases, as predicted by the theory of M. A. Krivoglaz. The irreversibility of the process leads to dissipation of the elastic wave energy. The experimental data on the damping of elastic oscillations during phase transitions in Cu–Be and Cu–In alloys were compared with the decrement values

calculated from Krivoglaz's theory and good agreement was obtained. (auth)

20561 DIFFUSION OF IRON IN ZIRCONIUM. A. M. Blinkin and V. V. Vorobev (Khar'kov State Univ.). Ukr. Fiz. Zh., 9: 91-5(Jan. 1964). (In Ukrainian)

The diffusion of iron in high purity zirconium was studied by radioisotopic tracers. A method was worked out for applying thin radioactive layers on the heated surface of the sample by evaporation from the solid phase. The variation of the absorption method of self-diffusion coefficient measurements, permits excluding the radioactive decay correction. The temperature dependence of the diffusion coefficient of iron in zirconium is: $D_{\alpha\text{-}Zr} = 2.5 \cdot 10^{-2}$ exp (–48000 1/RT) $cm^2 \cdot sec^{-1}$ and $D_{\beta\text{-}Zr} = 4 \cdot 10^{-2}$ exp (–30000 1/RT) $cm^2 \cdot sec^{-1}$. It is shown that the atomic mobility of iron in the zirconium lattice is higher than that of tantalum and tin.[3] (auth)

20562 APPLICATION OF THE X-RAY MICROANALYZER FOR THE INVESTIGATIONS OF THE BANDED STRUCTURE OF SINTERED ALUMINUM. Roger Theisen (European Atomic Energy Community, Ispra, Italy). Z. Metallk., 55: 128-34(Mar. 1964). (In German)

The chemical composition of the iron-rich inclusions in sintered aluminum products (SAP) was determined by quantitative static electron probe microanalysis. Similar to the change in mechanical characteristics of cold-worked SAP, a successive refinement of the banded structure at medium deformation and the breaking up of the homogeneous aluminum lines at highest amounts of deformation degrees was observed in metallographic study and in the differential-scanning methods. The dispersion of $FeAl_3$ inclusions in the Al_2O_3-rich heterogeneous matrix was analyzed and the drop in the mean particle diameter with increasing degree of deformation was followed quantitatively by an automatic and selective working attachment. (auth)

20563 PLASTIC DEFORMATION OF MOLYBDENUM SINGLE CRYSTALS IN DIRECT SHEAR. James Luther Youngblood. Thesis, Houston, Tex., Rice Univ., 1963. 177p.

Electron-beam zone-refined molybdenum single crystals were grown and tested in shear along the (1 1 0)-plane in the [1 $\bar{1}$ 1]-direction over the temperature range 120 to 500°K. The tests were designed primarily to evaluate the activation volume v* in the equation $\dot{\epsilon} = \dot{\epsilon}_0^* e^{-(H^* - v^*\bar{\tau})/kT}$, where $\dot{\epsilon}$ is the shear-strain rate, ϵ_0^* is a rate constant, $H^* - v^*\bar{\tau} = H$ is the activation energy at the temperature T, $\bar{\tau}$ is the effective stress, and k is Boltzmann's constant. The principal purpose was to find the processes controlling the deformation rate below room temperature. The activation volume was chosen as a key parameter because of its direct significance as the product blg, where b is the Burgers vector, l is the average distance between pinning points, and g is the activation distance. The measurement of v* was made by changing strain rate incrementally and observing the stress change in accordance with the relation $v^* = kT(\partial \ln \dot{\epsilon}/\partial \bar{\tau})_T$. The temperature, stress, strain, and strain-rate dependences of v* were evaluated and this behavior compared with that expected from different postulated models. The magnitude of v* ($9b^3$ at 120°K to $17b^3$ at 300°K) was too low to be explained by intersection mechanisms. Locking by impurity atmospheres was eliminated as a significant factor, since much of the analysis was based on strains greater than 30%. Two experimental observations contradicted predictions based on simple Peierls-stress or cross-slip mechanisms. These were that the activation volume always decreased with strain, and a drastic decrease of v* with temperature, which begins at about 300°K, was found to require structural rearrangement to bring it about. The last conclusion is based on yield point effects accompanying those temperature or strain-rate changes which moved the specimen from a low-v* region to a high-v* region of the deformation. Since both the Peierls-stress and the cross-slip mechanisms are based fundamentally on the lattice properties rather than the dislocation structure, these observations are very significant in that they imply that neither mechanism is governing the deformation. A mechanism based on non-conservative movement of jogs in almost pure screw dislocations was therefore proposed and is able to explain all the low-temperature results of the investigation. (Dissertation Abstr., 24: No. 9, March, 1964).

20564 WORK FUNCTION AND ADSORPTION PROPERTIES OF NIOBIUM AND PHOTOELECTRIC AND ADSORPTION PROPERTIES OF GALLIUM ANTIMONIDE. Robert Milton Oman. Providence, Brown Univ., 1963. 85p.

Two separate experimental research projects on the properties of atomically clean surfaces are described. Studies were made on the chemical and electrical properties of the binary semiconductor GaSb and surface properties of niobium. The photoelectric thresholds of the (1 1 1) and ($\bar{1}$ $\bar{1}$ $\bar{1}$) surfaces of GaSb were measured for both the ion bombarded surfaces and those cleaned by ion bombardment followed by annealing. The photoelectric thresholds, taken as the interçept of the plot of the photoelectric yield versus energy, for the annealed (1 1 1) surfaces are 4.86 ev for the gallium and 4.80 ev for the antimony while for the ion bombarded surfaces the values are 4.66 ev for the gallium and 4.72 ev for the antimony. An oxygen exposure of $1 - 10 \times 10^{-6}$ mm Hg min on the clean, annealed surfaces lowered the threshold of the gallium surface by 0.2 ev. A short heating of annealed surfaces that had previously been exposed to oxygen raised the thresholds 0.2 ev for both surfaces. Exposure of both surfaces to oxygen at $1 - 10 \times 10^{-4}$ mm Hg min while the crystals were radiation cooling from 400°C to room temperature lowered both thresholds to 4.76 ev. Exposure of both surfaces to the atmosphere lowered the threshold of the antimony surface 0.24 ev to 4.56 ev. The photoelectric properties of the 500 ev ion bombarded surfaces were not influenced by oxygen exposure at 1.5×10^{-6} mm Hg min but this same exposure on 1000 or 1500 ev bombarded surfaces lowered the threshold of the gallium surface to 4.54 ev. The interpretation of the results on the adsorption of oxygen is that the adsorption is taking place as molecules rather than as atoms. The effects of thermal and ion-bombardment etching are also described. The photoelectric work functions of atomically clean surfaces of three planes of niobium as measured by the Fowler method are: (1 1 1), 4.66; (3 3 5), 4.55; (1 1 0), 4.33 ev. The work function of ion bombarded (greater than one minute at 0.20 ma/cm^2 and 500 ev) surfaces of all three planes is 4.09 ev. The sticking coefficient for oxygen on the clean surfaces is 0.9 and on the ion bombarded surfaces is 0.2. The sticking coefficient for carbon monoxide on these surfaces was found to be at least an order of magnitude lower than the values quoted for oxygen. The work function of ion bombarded surfaces was found to be dependent on the extent of bombardment for bombardments of less than one minute carried out at 0.20 ma/cm^2. A work function of about 4.7 ev was ob-

served for a bombardment of 20 seconds on the (3 3 5) face. In this region where the bombardment amounts to the removal of less than 100 atomic layers the surface is apparently undergoing a rather rapid change with the extent of bombardment. Ion-bombardment etching effects observed on the three planes are similar to those observed on germanium and silicon. (Dissertation Abstr., 24: No. 9, March 1964)

20565 EMITTANCE MEASUREMENTS OF REFRACTORY OXIDE COATINGS UP TO 2900°K. V. S. Moore, A. R. Stetson, and A. G. Metcalfe (Solar, San Diego, Calif.). p.527-33 of NASA SP-31, "Measurement of Thermal Radiation Properties of Solids." Washington, D. C., National Aeronautics and Space Administration, 1963.

The hot-filament method for the measurement of total hemispherical emittance was adapted for ceramic coatings. The radiated energy per unit area is measured simply and accurately by potential probes in the uniform temperature region of the filament. Several methods were examined to determine the true surface temperature. An approximate solution was used in which it was assumed that the coating is a gray body. In this case, the true surface temperature and emittance are determined from the solution of simultaneous equations derived from the Wien and Stefan-Boltzmann Laws. A more accurate method is based on the use of the hot filament as a resistance thermometer. For opaque, non-conductive, uniform coatings, it can be shown that extrapolation of the resistance temperature to zero thickness coatings for constant energy radiated per unit area gives the true surface temperature for this density of radiation. An analysis of the sources of error shows that the method is capable of high accuracy if suitable filaments can be found for the ceramic coating under study. (auth)

20566 SOME PROBLEMS IN EMITTANCE MEASUREMENTS AT THE HIGHER TEMPERATURES AND SURFACE CHARACTERIZATION. C. D. Pears (Southern Research Inst., Birmingham, Ala.). p.541-51 of NASA SP-31, "Measurement of Thermal Radiation Properties of Solids." Washington, D. C., National Aeronautics and Space Administration, 1963.

The emittance of several refractory materials were determined at temperatures from 800 to 5000°F with an instrument in which the radiance of a specimen was compared with the radiance of a blackbody cavity at the same temperature. A thermopile type of detector was used. The emittance was found to be related to the structure of the material at the higher temperatures. Small disk-shaped specimens were placed on similar disks of tantalum or tungsten and heated inductively to a steady-state temperature. The surface temperature of the specimen was determined by thermocouples to 2500°F and by optical pyrometry to 5000°F assuming gray body distribution at the wavelength of the optical pyrometer (0.665μ). For the thermocouples, several methods of attachment were used depending on the nature of the structure of the specimen. For the temperature determinations by optical pyrometry, a method of iterating between the readings of the optical pyrometer and the total radiation detector was developed for the computer to permit the solution of true temperature. Major emphasis is directed to a requirement of instrument and techniques that must assume greater attention at the higher temperatures. Specifically, the emittance must be related to the structure of the surface of the specimen as a function of temperature and time. Surface characterization is mandatory. The analysis of the data must include photomicrographs that will reveal the topographical conditions, the chemistry of the surface with the high-temperature migration of contaminants of small quantity (ppm), and the structure which may alter considerably with temperature. (auth)

20567 TECHNIQUES OF MEASURING NORMAL SPECTRAL EMISSIVITY OF CONDUCTIVE REFRACTORY COMPOUNDS AT HIGH TEMPERATURES. T. R. Riethof and V. J. DeSantis (General Electric Co., Philadelphia). p.565-84 of NASA SP-31, "Measurement of Thermal Radiation Properties of Solids." Washington, D. C., National Aeronautics and Space Administration, 1963.

Techniques for measuring the spectral distribution of normal emittance over a wavelength bandwidth of from 0.4 to 5μ and up to temperatures of 3000°K is described. Special design features of the apparatus for heating the specimen, controlling specimen cavity atmosphere and semi-automatic recording of emittance are discussed. An approach to specimen characterization is proposed and the emittance of the borides of niobium, zirconium, and titanium are presented. In addition, the normal spectral emittances of zirconium, hafnium, and tantalum nitrides are described. (auth)

20568 POINT DEFECTS IN METALS. A. C. Damask and G. J. Dienes. New York, Gordon and Breach Science Publishers, 1963. 327p. $19.50.

The theoretical and experimental methods used in investigating the fundamental properties of crystalline irregularities of atomic dimensions in metals are presented. Representative investigations are discussed, and approximately 500 references are given. Annealing theory, analysis of annealing curves, physical properties of point defects, and some basic experiments are discussed. (R.E.U.)

20569 SOME THERMODYNAMIC PROPERTIES OF SODIUM–POTASSIUM ALLOYS. Vishwa Mitter Khanna. Thesis, New York, New York Univ., 1963. 137p.

The vapor pressures of Na and K and the activities of these elements in 4 Na–K alloys (containing 78.72%, 67.98%, 56.25%, and 41.51% of K) were determined at various temperatures by the optical absorption technique. The vapor pressures for the pure metals were found to be adequately represented by the following equations: $\log P_{Na} = -5872/T + 8.445$ (between 275 and 350°C); and $\log P_K = -4968/T + 8.192$ (between 225 and 350°C), where P is in mm and T is in degrees Kelvin. The heats of vaporization of Na and K as calculated from these expressions are 26.87 ± 0.22 kcal/mole and 22.73 ± 0.07 kcal/mole, respectively. The activity data show that the system deviates positively from Raoult's Law. The values of the activity obtained for Na were found to be considerably higher than those expected from the self-consistency rule, i.e., the Gibbs-Duhem equation. This discrepancy is attributed to the non-applicability of Beer's law to the vapors of this element over the alloys. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20570 DEVELOPMENT OF COATED FUEL PARTICLES FOR BERYLLIA BASED FUELS. P. G. Alfredson and R. C. Cairns (Australian Atomic Energy Commission). 13p. (CONF-281-29)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

A summary is given of the results of coated particle studies. Alumina and beryllia coatings were deposited on UO_2 and $(U,Th)O_2$ particles by chemical vapor deposition in a fluidized bed. Coating properties were shown to be a

function of coating temperature, reactant feed-rate ratio, and coating rate. For the coating temperatures investigated, the best conditions for coating deposition were determined. Fission gas release measurements were made on UO_2 particles coated with 40 μ of alumina deposited at 1000°C with an $AlCl_3/H_2O$ molar feed-rate ratio of approximately 0.36 and a coating rate of 2 to 3 μ/hr. In post-irradiation annealing experiments, approximately 0.07% of the contained ^{133}Xe was released in 5.5 hours at 900°C, and 1.4% was released in 28.5 hours in successive annealing experiments at temperatures up to 1300°C. (auth)

20571 THERMAL SHOCK TESTS ON BERYLLIA. R. W. Swindeman (Australian Atomic Energy Commission). 28p. (CONF-281-31)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The thermal shock resistance of beryllia was investigated by quenching thin disc specimens into liquid media. Specimens were quenched into water at 25°C, liquid metal over the temperature range from 140 to 500°C, and molten salt over the range from 160 to 630°C. Data were obtained on the relative shock resistance of hot pressed Pechiney and cold pressed and sintered Brush UOX materials. An attempt was made to determine the surface heat transfer coefficient for the quench media in order to be able to assess the thermal stresses corresponding to the failure conditions. The thermal stresses calculated by this technique were generally from 50 to 70% of the expected values. There was some evidence, based on mechanical tests, that the cold pressed and sintered specimens had low strength near the circumference. In this case there was fairly good agreement between the mechanical strength and the thermal stress data. (auth)

20572 RELEASE OF XENON 133 ON POST-IRRADIATION HEATING OF UO_2-ThO_2-BeO COMPACTS. A. R. Palmer, H. J. Whitfield, and R. Clark (Australian Atomic Energy Commission). 25p. (CONF-281-36)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Release of ^{133}Xe from irradiated specimens of $(U,Th)O_2$ dispersed in beryllia were examined by the technique of post-irradiation anneal. The specimens, prepared by hot-pressing, covered a density range 89 to 97% theoretical and were examined at temperatures up to 1600°C. Values of the gross diffusion coefficient D′ are given. It is considered that the release of gaseous fission products from such specimens is determined by diffusion within the solid fuel grain, followed by rapid diffusion along an open pore to the external surface. Open porosity connecting fuel grains to the external surface exists up to densities of 97% theoretical. The apparent activation energy for diffusion was determined to be approximately 106 kcal $mole^{-1}$. (auth)

20573 A STUDY OF VARIABLES IN THE MECHANICAL TESTING OF BERYLLIA. K. Veevers, J. F. Whatham, and W. J. Wright (Australian Atomic Energy Commission). 23p. (CONF-281-30)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Hot-pressed beryllia of 2.9 to 3.0 g/cm^3 density and 15 to 20 microns grain size was studied to determine the effects of specimen size, shape, surface finish, strain rate, prior mechanical treatment, and loading geometry on the modulus of rupture measured in four-point bending. The modulus of rupture was found to be insensitive to variations in volume of the test piece, prestraining, and loading geometry over the range studied; when considered as a normally distributed sample, the variations in modulus of rupture at the extremes of volume were not significant at the 95% confidence level. The standard deviation of results for a normal population was about 1900 psi. The results were analyzed according to the Weibull "weakest link" theory. Values of the Weibull "constant" varied from 10 to 35 with a mean of 16; the variations in modulus of rupture with volume under stress, predicted from this model were therefore small but probably significant at the 95% confidence level for a normal distribution. Specimens prepared with various surface finishes (20 to 150 micron abrasives) showed no significant variation in modulus of rupture. An increase in strain rate from 0.06% per minute (extreme fiber strain) to 1.2% per minute showed no significant increase in strength, but further increase in strain rate to 48% per minute resulted in 25% increase in the modulus of rupture. (auth)

20574 THERMAL VIBRATIONS IN BeO. A. W. Pryor and T. M. Sabine (Australian Atomic Energy Commission). 11p. (CONF-281-22)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Neutron diffraction patterns, taken on fine-grained poylcrystalline samples of BeO at various temperatures from room temperature to 900°C, were analyzed to determine the structure parameter and the nuclear vibration amplitudes. The structure parameter was found to be 0.3778 ± 0.001 at room temperatures increasing slowly to 0.3795 ± 0.001 at 900°C. The vibration amplitudes were correlated with specific heat results by assuming a simple model for the vibration spectrum. The temperature parameters at room temperature were found to be $B_O = 0.27 \pm 0.05$ Å^2 and $B_B = 0.35 \pm 0.06$ Å^2. The Debye parameter determined by diffraction was confirmed by observations of the coherent inelastic cross sections for 5 Å neutrons at temperatures up to 2000°K. (auth)

20575 THE STRUCTURE OF BERYLLIUM OXIDE. T. M. Sabine and B. Dawson (Commonwealth Scientific Industrial and Research Organization, Melbourne). 16p. (CONF-281-23)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

A description is given of a combined x-ray and neutron diffraction technique, which, in principle, can give the electron distribution over the unit cell. The technique was applied to beryllium oxide and it was concluded that the best simple description of the substance is $Be^{0.0}\ O^{0.0}$. The difficulties of obtaining accurate intensity data are discussed. (auth)

20576 THE ELECTRICAL CONDUCTIVITY OF BERYLLIUM OXIDE. A. W. Pryor (Australian Atomic Energy Commission). 14p. (CONF-281-21)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Assuming that beryllium oxide consists of Be^{2+} and O^{2-} ions, the lattice energy and compressibility were computed. Poor agreement with experimental values showed that the ionic hypothesis is an unacceptable description of beryllium oxide. Computations show that the energy of formation of doubly-ionized point defects is very high, which indicates that they could not be formed thermodynamically and, probably, that they could not even exist in the lattice. Measurements of the electrical conductivity are reported and were interpreted by assuming that beryllium oxide is an intrinsic electronic semi-conductor, with a band gap of about 5.2 volts. In vacuum, strong surface

conduction effects, which are ionic in character, are also present; these are suppressed by the absorption of any gas. Irradiation damage lowers the volume conductivity. (auth)

20577 THE BeO–MgO SYSTEM. J. Kordis (Australian Atomic Energy Commission). 8p. (CONF-281-10)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

X-ray powder diffraction and melting-point studies provide no evidence of the existence of any compound or solid solution in the BeO–MgO system. Samples investigated by x-ray diffraction were: powders of various stoichiometric compositions and powders of high BeO content, calcined at 1400°C for 87 hours; powders containing up to 4 mole % MgO, quenched from above 2100°C; and powders derived from quenched melts at near the eutectic composition. In all cases examined, the room temperature lattice parameters of BeO conformed to the limits $a_0 = 2.698 \pm 0.002$ and $c_0 = 4.378 \pm 0.004$ Å. A determination of the liquidus confirmed the existence of a single eutectic in the system, located at 69 ± 2 mole % BeO and 1838 ± 13°C. (auth)

20578 SUB-SOLIDUS EQUILIBRIA IN THE $CaO–ZrO_2$ SYSTEM. S. I. Fernandes and L. J. Beaudin (Norton Co., Chippawa, Ont.). 17p. (CONF-372-3)

From Annual Pittsburgh Diffraction Conference, Pittsburgh, Nov. 1963.

It is shown that the complex behavior of the sub-solidus region of the $CaO–ZrO_2$ system can be clarified by calling the limiting composition of the cubic phase, located at 20 mole % CaO below 1500°C, a definite compound $CaZr_4O_9$. Extensive solid solubility of ZrO_2 in this compound occurs. The solubility limit of ZrO_2 in $CaZr_4O_9$ is temperature dependent; as the temperature increases, so does the solubility. When any cubic solid solution of ZrO_2 in $CaZr_4O_9$ is cooled under equilibrium conditions it remains single phase cubic until the ZrO_2 solubility limit is reached. At this point ZrO_2 starts to precipitate out giving a binary system made up of ZrO_2 and a ZrO_2-saturated $CaZr_4O_9$ solid solution. Precipitation continues until all of the dissolved ZrO_2 has been ex-solved from the $CaZr_4O_9$ solution at about 800–900°C. The process can be reversed by heating the binary mixture to the starting temperature. The high-temperature cubic solid solutions of ZrO_2 in $CaZr_4O_9$ can be retained at low temperatures by quenching. (P.C.H.)

Radiation Effects

Refer also to abstracts 20089, 20627, and 21635.

20579 (AAEC/E-115) IRRADIATION OF BERYLLIUM AT ELEVATED TEMPERATURES. PART II. IRRADIATION OF RIG X-74 IN HIFAR. B. S. Hickman and G. Bannister (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Dec. 1963. 26p. (TRG-Report-532)

Beryllium metal specimens fabricated by various routes were examined after irradiation to fast neutron doses of 5.5×10^{20} to 9×10^{20} nvt at temperatures of 450, 550, and 650°C. The results were in general agreement with those reported previously for similar material irradiated to lower doses. Density changes of any significance were observed only at 650°C. Serious loss of high temperature ductility occurred in all materials and was again attributed to helium bubble formation at grain boundaries. Material fabricated by hot pressing and extrusion showed superior properties, both before and after irradiation, to material prepared by loose sintering and extrusion. (auth)

20580 (BNL-7964) OXIDATION RATES OF ALTERNATIVELY IRRADIATED AND ANNEALED, PERIODICALLY IRRADIATED AND ANNEALED AND CONTINUOUSLY IRRADIATED GRAPHITES. D. G. Schweitzer and R. M. Singer (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 25p. (CONF-474-1)

From US/UK Libby Cockcroft Graphite Chemistry Meeting, Richland, Wash., May 1964.

Oxidation rates and activation energies between 350°C and 500°C were obtained for pile grade graphite after seventeen cycles of neutron reirradiations and 350°C anneals. Although considerable radiation damage was retained after this treatment, neither the oxidation rates nor the activation energy could be distinguished from unirradiated control stock. Oxidation rates for pile grade graph ite were also obtained before and during the accumulation of 9 cycles of uniform neutron reirradiations and 350°C anneals. The rates at 400°C throughout this treatment did not significantly change. The defects responsible for the enhancement in oxidation after the first irradiation appear to be removed when the graphite is subjected to reirradiations and low temperature anneals. The only vacancy species expected in both the continuously irradiated and the cycled graphites is the monovacancy. It is therefore concluded that specific interstitial clusters cause the enhancement in oxidation observed after the first neutron irradiation. (auth)

20581 (FZK-172) MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. Quarterly Progress Report, June 1–August 31, 1963. E. E. Kerlin and E. T. Smith (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Sept. 30, 1963. Contract NAS8-2450. 122p. (NASA-CR-52319; N63-23807)

Tests were performed to measure the effects of various combinations of nuclear radiation, high vacuum, and cryotemperatures on nonmetallic materials used in nuclear-powered space vehicles. The materials consisted of adhesives, seals, thermal insulations, electrical insulations, structural laminates, potting compounds, and lubricants. Typical tests performed on specimens included lap-shear strength, ultimate tensile strength, ultimate elongation, stress-strain characteristics, weight loss, lubricity, compressive strength, spectral reflectivity, thermal conductivity, dissipation factor, dielectric strength, T-peel strength, and potted-wire pull-out strength. (R.E.U.)

20582 (NIRL/R/58) A GUIDE TO THE IRRADIATION STABILITY OF PLASTICS AND RUBBERS. R. Sheldon (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Sept. 1963. 23p.

An indication is presented of the irradiation stability of plastics and rubber materials. The indication helps the engineer to choose the most satisfactory material for any application involving exposure to irradiation. A list of common trade names and synonyms is appended. (auth)

20583 (PAN-473/II) ANNEALING PROCESSES IN GERMANIUM AFTER SHORT PULSE RADIATION DAMAGE BY FAST ELECTRONS. Progress Report. Henryk Rzewuski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw and Purdue Univ., Lafayette, Ind. Physics Dept.). Oct. 1963. 36p.

A progress report on the experimental investigations of

fast annealing processes of point defects in germanium introduced by Van de Graaff fast electrons is presented. The experiments performed up to the present time do not give definite evidence of fast annealing processes after irradiation with electrons above damage threshold energy; however, several methods of measurement, their limitations, and the result obtained are discussed at some length. Adaptation of the electron Van de Graaff machine for pulse irradiation is also described. (auth)

20584 (SC-R-64-120) THE INFLUENCE OF NEUTRON IRRADIATION ON THE DIMENSIONAL STABILITY OF STEEL. G. L. Eggert (Sandia Corp., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 17p. (CONF-495-1)

From Golden Gate Metals Conference, San Francisco, Feb. 1964.

Changes in the parameters of length, superficial residual macrostress, martensite c/a ratio, and amount of retained austenite were determined on hardened steel gage blocks subjected to reactor irradiation. A relationship between these changes is demonstrated. It is shown that the structural stability of hardened SAE 52100 steel when irradiated is dependent upon neutron dose and preirradiation fabrication methods. (auth)

20585 (WANL-TNR-109) IRRADIATION EFFECTS ON SELECTED SOLID LUBRICANT MATERIALS. David Freas (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). May 24, 1963. 36p.

Reported are the effects of irradiation on solid lubricant bearing materials composed of various combinations of solid lubricant materials, plastic binders, and metallic filler materials. Specimens of these solid lubricant bearing materials, along with specimens of solid lubricant coated stainless steel were incorporated in both partial pressure and hydrogen atmospheres in 14 capsules and were irradiated in the shuttle tube facility of the General Electric Test Reactor (GETR). These capsules were exposed to fast neutron fluxes of 10^{13} nv with resultant specimen temperatures ranging from 130 to 190°F. It was generally found that specimens containing Teflon as a plastic binder experienced extreme dimensional instability during irradiation, with several indications of Teflon decomposition. The specimens with DuPont Poly-imide binders and the specimens of stainless steel coated with a solid lubricant material, demonstrated excellent resistance to the irradiation conditions of these experiments. (auth)

20586 EFFECTS OF SIMULTANEOUS HEATING AND GAMMA RADIATION ON A LEAD FLINT GLASS. Larry A. Franks (Edgerton, Germeshausen & Grier, Inc., Santa Barbara, Calif.). Appl. Optics, 3: 647-8(May 1964). (TID-18939)

Gamma radiation produced optical transmittance losses in the glass were reduced by maintaining the glass at high temperatures during irradiation. Graphs of absorption coefficient change vs exposure for 5200 and 6750 Å at 21°C and of relative transmittance vs exposure for 6750 Å at 21, 66, 149, and 205°C are given. (M.J.T.)

20587 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF γ-IRRADIATED QUARTZ CRYSTALS ACTIVATED BY GERMANIUM. S. V. Starodubtsev and Sh. A. Vakhidov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 46-50(1963). (In Russian)

Studies of the nature of radiation defects in germanium-activated quartz showed specific x-radiation-induced electron paramagnetic resonance peaks. It is postulated that nonparamagnetic centers are formed by unpaired electrons localized on the admixture and surrounded by four oxygen atoms and one Li^+ and Na^+ ion. A hyperfine structure line appears as a result of ^{23}Na and ^{7}Li reaction with spins I = $^3/_2$. The kinetics and nature of radiation defects are studied by electric treatment and irradiation under various thermal conditions. (R.V.J.)

20588 THE EFFECT OF FOREIGN IONS ON THE ELECTRIC CONDUCTIVITY OF IRRADIATED ALKALI HALIDE CRYSTALS. Ya. N. Pershits, V. I. Gutman, and A. I. Anosova (Pskov State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 3-7(1964). (In Russian)

The effects of x rays on the electric conductivity of alkali halide crystals containing copper impurities were investigated. Color centers were produced. It is proposed that the decrease in the electric conductivity of the irradiated crystals is caused by the capture of electrons by the impurity ions. (tr-auth)

20589 EFFECT OF GAMMA RADIATION ON THE DIELECTRIC PROPERTIES OF SEVERAL CABLE MATERIALS. V. M. Nesterov, E. S. Nesmelova, N. I. Olshanskaya, and T. G. Mikhailova (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 147-52(1964). (In Russian)

The effect of gamma radiation on the dielectric properties of natural and synthetic rubber are investigated. The dependence of the dielectric loss tangent, the dielectric constant, and the electric conductivity of these materials on irradiation time is plotted. (tr-auth)

20590 RADIATION EFFECTS ON THE ELECTRONIC COMPONENTS AND ELECTRONIC EQUIPMENTS. I. GAMMA RADIATION EFFECTS ON ELECTRONIC COMPONENTS. Shigeru Hayakawa and Hiroshi Ikushima (Matsushita Electric Industrial Co., Ltd., Osaka). Natl. Tech. Rept. (Matsushita Elec. Ind. Co., Osaka), 8: 309-19(Sept. 1962).

In view of the importance of the dynamic properties in radiation environment, the electrical property variations of a number of the electronic components were measured during the course of γ-irradiation from a 2000-C ^{60}Co source at a center dosage rate of 5×10^5 r/hr or from a 100-C ^{60}Co source at 5×10^4 r/hr at energy levels of 1.17 Mev and 1.33 Mev. Test results indicated that the changes of component properties were observed mainly during irradiation and were transient in nature, disappearing after irradiation. In comparison to the data obtained from USA products, the results agreed only qualitatively and not quantitatively. Permanent effects were observed in resistors and transistors in varying degrees. (OID)

20591 NEUTRON RADIOGRAPHY OF IRRADIATED FUEL. Harold Berger and W. N. Beck (Argonne National Lab., Ill.). Nucleonics, 22: No. 5, 6-7(May 1964).

The advantage of neutron radiography for highly radioactive samples—that the sample activity does not interfere with the picture—is explained. Neutron radiographic inspection at ANL's Juggernaut reactor is described. Some film techniques are discussed. (M.J.T.)

20592 GAMMA-RADIATION INDUCED CURRENTS IN TEFLON. Bernhard Gross (International Atomic Energy Agency, Vienna). Nukleonik, 6: 20-3(Feb. 1964).

Absorption of gamma radiation in dielectrics is accompanied by a current (Compton current) which is due to the forward scattering of Compton electrons. Measurements

of this current are reported for radiation detectors with a teflon scatterer and a teflon or lead absorber. Polarization and surface effects were observed and radioinduced conductance was measured. With the help of a mathematical model the influence of conductance on short-circuit current and open-circuit voltage is discussed. (auth)

20593 THE SPECIFIC HEAT OF PLUTONIUM AT HIGH TEMPERATURES. A. E. Kay and R. G. Loasby (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Phil. Mag. (8), 9: 37-49(Jan. 1964).

Measurements of the specific heat of plutonium from room temperature to the melting point are described. The data are analyzed and an estimate is made of the electronic contribution to the specific heat term for the α, β, γ, and δ-phases. This term is large for all of these phases, and shows reasonable agreement with that derived from susceptibility data. (auth)

20594 THE THERMAL ACTIVATION OF SLIP IN NEUTRON-IRRADIATED COPPER. M. J. Makin (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 81-98(Jan. 1964). (AERE-R-4403)

The activation energy and activation volume of a slip process in which dislocations cut obstacles by a combination of stress and thermal activation can be obtained at any temperature by measurements of the local temperature, and strain rate, dependence of the flow stress. Results are given of such measurements at 77 and 293°K on neutron irradiated copper crystals in both the as-irradiated condition and after a mild annealing treatment (306°C for 251 min). Constant values of $(\partial \ln \sigma/\partial T)_{\dot{\epsilon}}$ and $(\partial \ln \sigma/\partial \ln \dot{\epsilon})_T$ were obtained during stage I of the deformation process at each temperature, enabling a single activation energy to be calculated. At the end of stage I, $(\partial \ln \sigma/\partial T)_{\dot{\epsilon}}$ and $(\partial \ln \sigma/\partial \ln)_{\dot{\epsilon}T}$ decrease to the unirradiated values, the decrease being sudden at 293°K and more gradual at 77°K. In both materials the activation energy and volume are temperature dependent, being much greater at 293°K than at 77°K. This temperature variation is considerably reduced by the annealing treatment, which affects principally the results at 77°K. Comparison of the results of the analysis with existing theories of lattice hardening shows that there is no adequate theory of the as-irradiated condition. The results show that this is due to the presence of a spectrum of obstacles with a wide range of activation energies. At low temperatures all the obstacles are effective, whereas at high temperatures the smaller obstacles become transparent to dislocation movement. Annealing reduces the width of the dispersion, largely by removing the smaller obstacles, and the theory derived by Seeger for hardening by a single type of obstacle is then much more closely obeyed. (auth)

20595 THE STRENGTH OF IRRADIATED MAGNESIUM OXIDE. R. A. J. Sambell and R. Bradley (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 161-6(Jan. 1964). (AERE-R-4433)

Magnesium oxide single crystals were irradiated in a reactor to neutron doses in the range 2×10^{19} to 2×10^{20} nvt >1 Mev. Any irradiation in this dose range prevents slip occurring below a stress of at least 1.3×10^2 Kg mm^{-2} which was the maximum fracture stress observed (cf. 10 Kg mm^{-2} as a typical flow stress before irradiation). The source of fracture is sometimes associated with pits produced by polishing and sometimes with impurity precipitates within the body of the crystal. (auth)

20596 NOTE ON THE PAPER OF D. E. PEACOCK AND A. A. JOHNSON, ENTITLED: "STAGE III RECOVERY IN NEUTRON IRRADIATED MOLYBDENUM AND NIOBIUM." J. Nihoul (CEN, Mol, Belg.). Phil. Mag. (8), 9: 167-70(Jan. 1964.)

A re-analysis of the isothermal annealing curves of neutron irradiated niobium indicates that stage III of the high melting point is caused by a second-order recovery process. (L.B.S.)

20597 THE GROWTH OF NEUTRON IRRADIATED MAGNESIUM OXIDE. D. H. Bowen and F. J. P. Clarke (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 413-21(Mar. 1964).

Electron microscope studies of neutron irradiated magnesium oxide single crystals have been correlated with macroscopic growth and x-ray measurements. At a dose of 3×10^{19} nvt > 1 Mev it is shown that the presence of irradiation induced defect clusters accounts for about a quarter of the macroscopic growth. At a dose of 4×10^{20} nvt > 1 Mev the loops become so large that they degenerate into a tangle of dislocation lines; in this form the damage is very resistant to annealing and even after an hour at 1800°C a quarter of the irradiation growth is still retained. (auth)

20598 VOLUME EXPANSION AND COLORATION IN X-IRRADIATED SODIUM CHLORIDE. M. F. Merriam (Univ. of California, San Diego, La Jolla), D. A. Wiegand, and R. Smoluchowski. Phys. Chem. Solids, 25: 273-92 (Mar. 1964).

The growth and thermal annealing of the volume expansion produced in NaCl by prolonged exposure to penetrating x rays at room temperature was studied by a photoelastic technique. Growth and annealing of the visible optical absorption bands were also measured. The growth curves for volume expansion and coloration are mutually consistent, within experimental error and theoretical uncertainties. The latter are, however, too large to permit unambiguous determination of the types of defects generated by irradiation. The F-center growth curve is of the type reported for KCl, that is, it contains an inflection point. The M- and F-band absorption constants are quadratically related in a manner consistent with previous evidence for the double F-model of the M-center. Annealing of the volume expansion and the optical absorption is in general agreement with the earlier results on NaCl bombarded with high energy protons but better resolution was obtained. The annealing is highly structure sensitive and details of the annealing curves were not completely reproducible. Kinetic analyses indicate that the annealing of volume expansion is limited initially (200–250°C) by diffusion of negative ion vacancies or by close pair vacancy-interstitial recombination. An interesting after effect in the annealing of the volume expansion may be connected with radiation enhanced impurity precipitation. Profiles of the photoelastically measured strain as a function of distance from the crystal midplane were obtained experimentally and compared with those calculated from the one dimensional theory. (auth)

20599 RELATIONSHIP BETWEEN NEUTRON-PRODUCED PRISMATIC DISLOCATIONS AND THE CHANGE IN VOLUME DURING ANNEALING IN COPPER. I. G. Greenfield and J. R. Demos (Franklin Inst., Philadelphia). Phys. Rev., 134: A1051-8(May 18, 1964).

Two groups of copper single crystals of various orientations were irradiated with neutrons in the BNL reactor between 50 and 70°C; one group was exposed to 0.53×10^{18} and the other 1.1×10^{18} nvt (total epicadmium flux). An irradiated and nonirradiated crystal of each orientation were isothermally annealed in a specially constructed dilatome-

ter at temperatures ranging from 75 to 350°C, and the irreversible differential changes in length were measured. In addition, electron microscope studies were made of the size distribution of irradiation-produced prismatic dislocations after several of the annealing treatments. These experiments revealed that (1) a direct relationship exists between the magnitude of shrinkage after annealing treatments and the total neutron exposure, (2) during annealing dislocation loops decrease in diameter until they disappear, (3) the decrease in dislocation density is related to the volume shrinkage, (4) the changes in loop distribution could be predicted by a line-tension-climb equation, and (5) the activation energy for the annealing of irradiation-produced loops lies between 2.08 ev and 2.10 ev. The results indicated that the annealing process in neutron-irradiated copper is not the same as that observed in quenched metals although a self-diffusion mechanism appears to be the controlling factor. (auth)

20600 WORK HARDENING OF NEUTRON-IRRADIATED COPPER SINGLE CRYSTALS. I. WORK HARDENING CURVES. Armin Rukwied (Max-Planck-Institut für Metallforschung, Stuttgart). Z. Metallk., 55: 146-52(Mar. 1964). (In German)

A systematic investigation of the work hardening curve of neutron irradiated copper single crystals and its dependence of neutron dose, deformation temperature, and strain rate revealed that the work hardening behavior differs in different ranges of the irradiation dose. These differences were shown by different shapes of the shear stress vs. shear strain curves. The critical resolved shear stress, however, did not exhibit such differences dependent on irradiation dose. With increasing dose, four different types of curves were observed. The dose range, within which a transition from one type of curves to the next occurs depended on deformation temperature and strain rate. With increasing deformation temperature the transitions were shifted to lower neutron doses. All four types of work hardening curves may roughly be subdivided, similar to the work hardening curves of unirradiated crystals into three stages: a flat initial stage, which, apart from a very weak dose of irradiation, consists of yield point elongation zone with propagation of Luders bands; a rather steep intermediate stage; and a final stage with decreasing slope. Within these stages, particularly within the second stage, numerous substages with a slightly differing work hardening behavior were observed. (auth)

20601 EFFECT OF RADIATION ON METALS AND OTHER HIGH-MELTING MATERIALS. V. V. Penkowskii. New York, American Elsevier Publishing Co., Inc., 1964. 206p. $14.50.

Information is included on theory of radiation damage in metals and other high-melting materials, radiation effects on properties of metals and alloys, including expansion, phase transformations, aging and ordering processes, electrical properties, magnetic properties, mechanical properties, elastic constants, and radiation effects on properties of nonmetallic materials, including graphite, diamonds, quartz, glass, metal oxides, solid solutions, and cermets. Experimental methods are briefly mentioned. 500 references are included. (P.C.H.)

20602 SOME FACTORS AFFECTING THE STATIC BREAKDOWN VOLTAGE OF UNIFORM-FIELD SPARK GAPS. D. T. A. Blair, F. M. Bruce, and D. J. Tedford (Royal Coll. of Science and Tech., Glasgow). p.321-26 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Measurements were made of initial ionization currents and of static breakdown voltages in radium-irradiated uniform-field spark gaps of 1 to 3 cm in room air, using different cathode materials. A humidity correction for breakdown voltage established for non-irradiated gaps was found to apply also to gaps with radium irradiation. The effect of repeated sparkover on the breakdown voltage was investigated, both with the gap enclosed and in the open atmosphere. The values of breakdown voltage are in good agreement with those reported by others. (auth)

20603 NUCLEAR RADIATION EFFECTS ON POTENTIAL NUCLEAR SPACECRAFT THERMAL CONTROL MATERIALS. J. E. Gilligan (Lockheed Missiles and Space Co., Sunnyvale, Calif.). 42p. (CONF-187-120)

From American Nuclear Society Meeting, New York, Nov. 1963.

Nuclear radiation induced changes in the thermal radiative characteristics of potential thermal control materials for nuclear spacecraft applications were investigated. Damage, manifested primarily by changes in solar absorptance, occurred in all irradiated nonmetallic systems, but varied greatly in degree. Such parameters as total dose, environmental test conditions, and sample temperature and preparation history, obviously affected damage magnitude. Materials exposed to concurrent nuclear and ultraviolet radiations (in vacuo) displayed strong interaction effects. Estimates of overall anticipated performance, based on both nuclear and conventional test data, indicated that few materials could satisfy the more critical thermal requirements of the Agena vehicle in Agena/SNAP-10A spacecraft. Furthermore, it was apparent that state-of-the-art thermal control materials are not sufficiently stable for high reliability, long lifetime (greater than one year) nuclear spacecraft missions. (auth)

20604 ELECTRON IRRADIATION OF BERYLLIUM OXIDE. D. G. Walker (Australian Atomic Energy Commission). 16p. (CONF-281-15)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Changes of the order of 0.01% in macroscopic and x-ray density were observed when polycrystalline and single crystal specimens of beryllium oxide were irradiated by 1 Mev electrons to doses approaching 10^{21} electrons per square centimeter at about 100°C. However, in similar experiments on polycrystalline material, previously neutron irradiated at 100°C, substantial annealing of the neutron damage occurred; the change in x-ray lattice parameters at an electron dose of 3×10^{20} electrons per square centimeter corresponded to that produced by thermal annealing for one hour at 800°C. Calculation of the number of displacements produced by the fast electrons suggests that electron induced defects recombine at ambient temperature; however, in previously neutron irradiated material the recombination competes with the annihilation of neutron induced defects. (auth)

20605 STUDY OF THE PROPERTIES OF BERYLLIUM OXIDE BEFORE AND AFTER IRRADIATION. J. Elston, H. Frisby, and C. Labbe (Commisaariat a l'Energie Atomique, Saclay, France). 61p. (CONF-281-6). (In French)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Bricks of BeO containing 0.6% CaO by weight and with a density of 2.80 ± 0.01 g/cm^3 were fabricated by natural fritting at 1600°C, and their mechanical and physical properties were determined. The effects of thermal shocks (rapid air-cooling) on the bricks were studied. Ultrasonic

examination showed that fissures in the blocks developed mainly from small defects present before the shock. Samples were also irradiated at 900°C to 2×10^{20} n/cm^2, and their physical and mechanical properties and thermal and electrical conductivities were studied. Electron microscopy and electron paramagnetic resonance were successfully used to study defects produced by the irradiation. The production of helium under irradiation was also investigated. (D.C.W.)

20606 AN ASSESSMENT OF THE EFFECT OF RADIATION-INDUCED LATTICE GROWTH ON THE STRENGTH OF BeO. H. Nolle (Australian Atomic Energy Commission). 20p. (CONF-281-16)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Expressions were derived for critical crack length in brittle material subjected to external load and internal stresses due to anisotropic crystal growth. The expressions were applied to randomly oriented polycrystalline BeO leading to a set of curves that shows the relationship between strength of material and crystal lattice growth. Consideration of the nature of internal strains set up by the lattice changes lead to the conclusion that the magnitude of the stresses is independent of grain size. The mechanical strength of the material will become a function of grain size when grain boundaries are treated as being effective in arresting the formation of stable cracks or when the assumption is made that maximum flaw dimensions are proportional to grain size. Analysis using available experimental data shows that in BeO the maximum compressive to tensile stress ratio is of the order of 10. At high integrated doses this will lead to compressive stresses approaching the crushing strength of BeO and may be a contributing factor in radioinduced crumbling of BeO. (auth)

20607 AN INTERPRETATION OF SOME X-RAY DIFFRACTION EFFECTS IN IRRADIATED BERYLLIUM OXIDE. T. M. Sabine (Australian Atomic Energy Commission). 15p. (CONF-281-12)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

An analysis was made of the intensity distribution of x rays scattered by hcp crystals containing clusters of interstitial atoms in the C position of the AB lattice. The predictions are shown to be consistent with the experimental observations of others on irradiated beryllium oxide. (auth)

20608 X-RAY DIFFRACTION STUDIES OF IRRADIATED BERYLLIUM OXIDE. D. G. Walker, R. M. Mayer and B. S. Hickman (Australian Atomic Energy Commission). 27p. (CONF-281-11)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The two types of x-ray line broadening in irradiated beryllium oxide were investigated in more detail. It was confirmed that the $\{h\,k\,0\}$ line broadening is due to intergranular strain. The $\{h\,k\,1\}$ reflections in powder photographs consist of a sharp low angle reflection with a diffuse high angle tail and the sharp reflections give self-consistent values for the lattice parameter. The dependence of the intensity of the sharp reflection on dose, irradiation temperature, and reflecting plane is discussed. Further studies of the $\{h\,k\,1\}$ broadening using single crystal techniques are described. Results are presented of the variation of the lattice parameters with neutron dose and irradiation temperature. For irradiation at 75–100°C the $\underline{a}$ parameter change saturates at 5×10^{20} nvt but the $\underline{c}$ parameter continues to increase up to the highest dose at which it can be measured (10^{21} nvt). For irradiation at 500–700°C the $\underline{a}$ parameter change is negligible and the $\underline{c}$ parameter change is much smaller than for equivalent doses at 75–100°C. The lattice thermal expansion measured in the range 20 to 1000°C is anisotropic but is unaffected by irradiation. (auth)

20609 COMPARISON OF MACROSCOPIC AND X-RAY GROWTH IN IRRADIATED BeO SINGLE CRYSTALS. B. S. Hickman, D. G. Walker, and R. Hemphill (Australian Atomic Energy Commission). 18p. (CONF-281-13)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Measurements are reported of the changes in lattice parameters, macroscopic density, and dimensions after irradiation of beryllium oxide single crystals at 75–100°C to fast neutron doses from 8×10^{18} to 6.5×10^{20} nvt. Excellent agreement between the macroscopic and x-ray growth in the as-irradiated condition and an increased rate of expansion was observed above $1-2 \times 10^{20}$ nvt. On annealing material irradiated to low doses (up to 6×10^{19} nvt) the macroscopic density and x-ray density recovered together over the temperature range up to 1100°C. At higher doses relatively less annealing occurred at low temperatures and the x-ray density recovered more rapidly than the macroscopic density at temperatures above 800°C. It was concluded that approximately equal number of interstitials and vacancies must be present after irradiation and that annealing occurs by mutual annihilation except in the case of high dose crystals at annealing temperatures above 800°C. (auth)

20610 DIRECT OBSERVATION OF DAMAGE IN NEUTRON IRRADIATED BERYLLIUM OXIDE. J. H. Chute and D. G. Walker (Australian Atomic Energy Commission). 22p. (CONF-281-14)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Transmission electron microscopy was used to observe damage produced in BeO by fast neutron bombardment at temperatures of 75°C and 500–700°C for doses ranging from 6.5×10^{19}–1.5×10^{21} nvt. After irradiation at 75°C the damage was in the form of dark spots 30–70 Å in diameter. For irradiation at 500–700°C the damaged areas were larger, up to ~300 Å diameter and were usually resolvable into dislocation loops lying perpendicular to the $\underline{c}$ axis. Some observations were made on the annealing behavior of the damage at temperatures up to 1400°C. Damage produced in the microscope by electron bombardment, and other microstructural features are discussed. The observed damage was compared with results obtained by indirect methods, such as neutron scattering, x-ray lattice parameter, and thermal conductivity measurements. (auth)

20611 THERMAL CONDUCTIVITY AT LOW TEMPERATURE OF NEUTRON-IRRADIATED BeO. A. W. Pryor, R. J. Tainsh, and G. K. White (Commonwealth Scientific and Industrial Research Organization, Sydney). 21p. (CONF-281-20)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Measurements are reported of the thermal conductivity of polycrystalline BeO in the temperature range 2 to 300°K. Samples were measured in the normal state and then after receiving fast neutron doses of 2.0×10^{18} to 2.0×10^{20} nvt. The measurements were undertaken in order to study the

phonon scattering from radioinduced defects. For the unirradiated material the scattering is adequately described by a combination of phonon interaction processes, grain-boundary scattering, and point scattering from impurities of unknown origin. For the irradiated material it is necessary to suppose that the defects consist predominantly of extensive planar clusters, which anneal in the temperature range 900 to 1100°C, and of a lower concentration of point defects that anneal below 600°C. The thermal resistance introduced by irradiation begins to saturate at doses of about 5.0×10^{19} nvt owing, it is thought, to multiple scattering from the co-planar clusters. The measurements give an order-of-magnitude confirmation of earlier estimates of the defect concentration. (auth)

20612 PRELIMINARY OBSERVATIONS OF THE RELEASE OF TRITIUM FROM IRRADIATED BERYLLIA. E. Rothwell (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). 16p. (CONF-281-18)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Post-irradiation annealing experiments are reported for beryllia compacts irradiated below 150°C to 3×10^{19} nvt (>1 Mev) and for powder obtained from a compact irradiated to 3.5×10^{20} nvt (>1 Mev). Release rates were measured in the temperature range 300 to 1650°C. An initial burst of tritium was observed on attaining temperature in each case and prolonged annealing was found to be necessary at most temperatures before true diffusion conditions were established. The apparent diffusion coefficient (D′) was calculated from the linear portion of the total counts versus (annealing time)$^{\frac{1}{2}}$ curve. The activation energy for tritium release for the temperature range 700–1000°C was found to lie in the range 70–100 kcal/mole. At temperatures below 700°C a lower activation energy was indicated and at very high temperatures (>1200°C) some evidence was obtained from compacts that unexpectedly low diffusion rates existed although this was not confirmed with the powder sample. (auth)

20613 THE DIFFUSION OF TRITIUM FROM IRRADIATED BERYLLIUM OXIDE POWDERS. A. R. Palmer, D. Roman, and H. J. Whitfield (Australian Atomic Energy Commission). 12p. (CONF-281-17)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The release of tritium from irradiated beryllium oxide powders was studied by the method of post-irradiation anneal. Over the temperature range 400–650°C, the release is a diffusion controlled process with an activation energy of 24 kcal. The diffusion coefficient of tritium in the two powders studied is given by $D_{UOX} = 6.6 \times 10^{-13} \exp - 24{,}500/RT$ and $D_{MINOX} = 7.6 \times 10^{-13} \exp - 24{,}000/RT$. The precautions necessary to obtain reliable results are described. (auth)

20614 THE ELECTRON SPIN RESONANCE IN GAMMA-IRRADIATED SINGLE CRYSTALS OF BeO. J. R. W. Thyer (Monash Univ., Victoria, Australia). 11p. (CONF-281-19)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Three types of damage centers were identified in the electron spin resonance spectra of gamma irradiated single crystals of BeO. One band consists of four equally spaced lines centered around g = 2. The other two centers overlap at the X-band and are clearly resolved at the Q-band where they have four times their X-band separation. The effects of rotation of the crystal from the parallel axis to both perpendicular axes was studied as well as the effects of rotation about the c-axis in order to determine the nature of the defects causing the spectra. The results are discussed. (P.C.H.)

20615 THE EFFECTS OF FISSION PRODUCT DAMAGE IN BeO DISPERSION FUELS. G. L. Hanna, R. J. Hilditch, and B. S. Hickman (Australian Atomic Energy Commission). 17p. (CONF-281-35)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

Hot-pressed, and cold-pressed and sintered, dispersions of $(U,Th)O_2$ in the BeO were irradiated with thermal neutrons to study the effects of fission product damage. Most specimens were "coarse dispersions" containing 3 to 30 vol % of 100 to 200 μ fuel particles. Two "fine dispersions" of each type containing minus 50 μ fuel particles were also irradiated. Fission densities ranged from 2×10^{19} to 2×10^{20} fission cm^{-3} of specimen or 4.5×10^{20} to 18×10^{20} fission cm^{-3} of $(U,Th)O_2$. Irradiation temperatures were between 600 and 850°C. Peak thermal stresses were generally between 2,200 and 20,000 psi but some specimens experienced stresses of 24,000 to 32,000 psi. The hot-pressed fine dispersions swelled slightly more than similar coarse dispersions but both fine and coarse cold-pressed specimens swelled by similar amounts (over 1%) at 2×10^{20} fission cm^{-3}. Swelling in all other coarse dispersions was not greater than 0.75%. No specimen failed due to thermal-stress fracture. Metallography revealed little change in microstructure after irradiation but fission gas bubbles were observed after post-irradiation annealing at 1250 and 1500°C. X-ray diffraction profiles contained from hot-pressed specimens revealed considerable strain in the matrices of both coarse and fine dispersions. Some of the strain in the coarse dispersions is thought to be due to stresses imposed by fuel-particle swelling. (auth)

20616 THE EFFECT OF NEUTRON IRRADIATION ON THE LOW TEMPERATURE DIELECTRIC RELAXATION IN FUSED SILICA. R. E. Jaeger (Bell Telephone Labs., Inc., Murray Hill, N. J.) and H. T. Smyth. 28p. (CONF-478-1)

From American Ceramic Society Glass Division Meeting, Bedford, Penna., Oct. 1963.

The effects of neutron bombardment on the 30°K loss relaxation, which occurs in fused silica, were investigated. Three specific types of Engelhard silica were measured having OH ion concentrations ranging from 3 ppm to 1000 ppm. Each type was irradiated to the following levels with neutrons having energies between 0.01 and 1 Mev: 3.8×10^{16}, 6×10^{17}, 2×10^{19}, 5×10^{19} neutrons/cm^2. A Boonton Electronics Model 74-C capacitance bridge was used to make the electrical measurements at a frequency of 100 kilocycles/sec. Tan δ was determined in the temperature range from 1.4 to 140°K using a liquid helium cryostat. A new peak, which has not been previously reported, was observed near absolute zero. The effect of OH ion concentration as well as neutron bombardment on this peak is also discussed. (auth)

METEOROLOGY

20617 (COO-1199-3) RADIOACTIVE RAINOUT RELATIONS ON DENSELY GAGED SAMPLING NETWORKS. F. A. Huff (Illinois. State Water Survey, Urbana). Mar. 1964. Contract AT(11-1)-1199. 28p.

Studies were made of the relationship between the rainout of radioactivity in convective storms and three rainfall factors, rainfall volume, storm duration, and rainfall rate. Data were used from four densely gaged sampling networks operated during the spring and summer of 1962–1963 in central Illinois. The network areas ranged from 10 to 6000 square miles, and provided data on both microscale and mesoscale relationships. Analyses of spatial variability showed a trend for the relative variability of radioactive rainout to (1) exceed the storm rainfall variability, (2) decrease with increasing rainfall volume and storm duration, and (3) increase with increasing network size. Investigation of the point representativeness of single measurements of radioactive rainout indicated that an average error of 20 to 25 percent is introduced when a single observation is assumed to represent the mean rainout over areas of 10 to 12 square miles. Correlation analyses indicated that the rainfall at a given point is not strongly related to the radioactive rainout at that point. However, when areal patterns of rainfall and rainout are compared, and allowance made for displacement of high and low centers due to various meteorological influences, a strong association is indicated between the major features of the patterns in most storms. (auth)

20618 (NP-13799) AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR. First Quarterly Progress Report. Report R-173-1. M. N. Hirsh and P. N. Eisner (Dewey (G. C.) and Co., Inc., New York). Sept. 30, 1963. 19p.

The reaction rates for various charge production and loss mechanisms in electron-irradiated air and atmospheric gases are to be studied. The vacuum system was modified to permit bakeout at temperatures up to 400°C. Preliminary results indicate that with bakeout to 250°C, pressures in the 10^{-8} torr range can be obtained. The design of the r-f mass spectrometer was completed, and the instrument was built. Tests on its vacuum system resulted in a pressure of 2×10^{-8} torr without baking. The spectrometer will be used to identify and measure ions and neutrals. (D.C.W.)

20619 (TID-20511) STRATOSPHERIC WIND TEMPERATURE AND ISOBARIC HEIGHT CONDITIONS DURING THE IGY PERIOD. PART II. Report No. 10. Li Peng (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Dec. 15, 1963. Contracts AT(30-1)-2241 and AF(604)-5223. 211p.

The stratospheric wind temperature and isobaric height conditions of the Northern Hemisphere during the period from January to June 1958 are analyzed in detail. Three month seasonal averages of these quantities and of the correlations between them are computed and presented in the form of hemispheric maps. Zonal averages of various important quantities are also given in tables. A general discussion of the results from the viewpoint of energy and momentum is given briefly. A revision of Russian wind data in part I of the study (RDA 4: 445) is given. (auth)

20620 DIFFUSION OF SMALL PARTICLES IN A NON-UNIFORM ATMOSPHERE. Kwang Yu and Milton M. Klein (Geophysics Corp. of America, Bedford, Mass.). Phys. Fluids, 7: 651-7(May 1964).

The downward motion of small particles in an isothermal turbulence-free atmosphere was studied for the case of variable diffusion coefficient, utilizing two models. In the first of these, the diffusion coefficient was taken as an exponential function of altitude, while in the second the variation was assumed parabolic. Analytic solutions were obtained for one dimensions and three dimensions for both models. The calculations, which were restricted to the exponential case, show the development of a profile of constant shape which moves with the same velocity, independent of the mass of the particles. These results, which are derivable from the solution, are in agreement with the numerical work of Banister and Davis. It is also shown that the qualitative nature of the results for late time is independent of the initial distribution. (auth)

PHYSICS

General

20621 (AFCRL-62-1075) THE STUDY OF HYDROMAGNETIC PROBLEMS BEARING ON GEOMAGNETISM. Final Report. S. Chandrasekhar (Yerkes Observatory, Williams Bay, Wis.). Jan. 1, 1962. Contract AF19(604)-2046. 40p. (AD-417336)

The thermal instability of fluid spheres, hydrodynamic and hydromagnetic stability of fluid flows, and configurations in gravitational equilibrium have been studied over a number of years, together with associated topics in plasma physics and mathematics. The publications arising from these studies are listed, and abstracts are presented for thirty-eight papers published. (D.C.W.)

20622 (COO-1044-16) COLOR CENTERS AND RELATED PHENOMENA IN ALKALI HALIDE TYPE CRYSTALS. Theodore J. Neubert (Illinois Inst. of Tech., Chicago. Freund Instrumentation Lab.). Apr. 1964. Contract AT(11-1)-1054. 8p.

The research program being conducted on radioinduced color centers in alkali halide crystals and some of the results obtained are described briefly. A description is given of the design of a simple controlled semi-low-temperature color-center cell for the measurement of the optical absorption spectrum of a crystal specimen before and after color center production by x or γ rays. (D.L.C.)

20623 (JINR-P-1565) RASPROSTRANENIE VOLN V STRUKTURNOM VOLNOVODE I IZLUCHENIE ZARYADA, PROLETAYUSHCHEGO PO EGO OSI. (Wave Propagation in a Structural Waveguide and Radiation of a Charge Flowing Along its Axis). O. A. Kolpakov, V. I. Kotov, and San Kha Om (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 19p.

The conditions of propagating electromagnetic waves in some special types of corrugated waveguides are investigated. The dispersion equations were obtained and analyzed. On this basis the question of the radiation of the charge flowing along the axis of such waveguides is considered. (auth)

20624 (LADC-5814) COMMENTS ON THE STABILITY OF STEP SHOCKS. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-36. 5p.

Gardner's explanation of shock instability with the piston removed to infinity is discussed. The piston problem for an equation of state exhibiting instability is examined, and Hugoniot curves with the unstable region located on the segment of negative slope are considered. Several unsolved problems with regard to the Hugoniot curves are pointed out, and additional interpretations are given of the stability condition. Instability in the high pressure region is also considered. (D.L.C.)

20625 (N63-21469) RADIATION DAMAGE BY COMPTON SCATTERING IN GAMMA- OR X-RAY PUMPED OPTICAL MASERS. R. A. Shatas (Army Missile Command, Redstone Arsenal, Ala.). Apr. 15, 1963. 15p. (RR-TN-63-2)

The computation of threshold energies of x rays and gamma rays for the displacement of a lattice element by the nuclear Compton scattering is reported. Numerical results are given for alkali halides and oxides. These computations were carried out as a part of a general feasibility study of direct pumping of optical masers by radiations emitted in the nuclear fission of transactinides. Based on the analysis of the fission data for ^{235}U, it is concluded that the direct pumping is not yet technologically feasible because: (1) only a small fraction of the total energy released by the nuclear fission can presently be made available in x rays and gammas. (2) serious radiation damage to the optical maser material would occur if fast neutrons or high-energy gammas were used in pumping. As an alternate, the conventional conversion of fission energy into electricity and the electrical pumping by carrier injection into recombination radiation devices is suggested. (auth)

20626 (NP-13800) EFFECT OF IMPURITIES OF CESIUM FUEL UPON ION ENGINES. Quarterly Progress Report No. 3, December 1, 1963 – February 29, 1964. B. A. Free and J. W. Carter (General Electric Co. Spacecraft Dept., Cincinnati). Contract AF33(657)-9163. 39p.

The effects of potassium and sodium on the performance and properties of cesium fuel of ion engines are evaluated. Information is included on: gas flow through porous tungsten emitter before and after operation; emitter porosity; collector current and critical temperature behavior; effect of sintering on flow rate; effects of increased arrival rate, boiler temperature, and increased extraction potential on critical temperature, and decontamination. (N.W.R.)

20627 (NP-13815) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Fourth Quarterly Progress Report, September 16, 1963 through December 15, 1963. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). 70p.

Direct evidence was obtained for the two-photon decay of the metastable state of the He ion. Coincident counts were obtained between vacuum ultraviolet photon detectors which are exposed to a beam of metastable He ions. These coincidences are removed when the metastable ions are quenched with a suitable r-f electric field. This is the first direct evidence for the validity of the proposed two-photon decay mode of metastable hydrogenic atoms, and it is also the first experimental example of two-photon emission. Double-resonance and level-crossing studies of the excited states of the chromium atom are continuing. Precise values of the g_J factors and hyperfine splittings were obtained and are being interpreted on the basis of core polarization and configuration mixing effects. Preliminary results were obtained in an experiment designed for the determination of the fine and hyperfine structure of the $(1s2p)^3P$ term in the Li ion. It was shown that the metastable autoionizing Li atom may be partially quenched with a magnetic field of several thousand gauss. The result is consistent with our expectations and indicates the ultimate success of polarization experiments. Partial success has been achieved in the fabrication of optical double-resonance cells for chemically reactive elements such as Ca. Theoretical studies are continuing on laser quenching of metastable atoms. Further results were obtained on the motional broadening of Rayleigh scattered light. An oscillation parameter of greater than unity was obtained with a pulsed optically pumped Rb hyperfine maser. Studies of the microwave properties of model planetary atmospheres are continuing, and a model of

the Venusian atmosphere was constructed which is consistent with all available data. (auth)

20628 (NP-13844) A NOTE ON THE ELECTRONIC STATES IN LIQUID METAL. Technical Report, Ser. A, No. 99. Mitsuo Watabe and Minoru Tanaka (Tokyo Univ. Inst. for Solid State Physics). Dec. 1963. 27p.

The energy spectrum of valence electrons in liquid metals is investigated with the nearly-free-electron approximation. The spectrum in monovalent (alkali) liquid metals is essentially the free one with small increase of the density of states on the Fermi surface. In a case of polyvalent metals, the spectrum is distorted by the electron-ion interaction reflecting complicated ionic distribution. The density of states near the Fermi surface increases by a factor of about two from that of free electrons. The energy spectrum seems to characterize a liquid metal from others to some extent as it does a solid. Qualitative feature of several electronic properties is discussed in relation to the ionic density correlation, i.e., the structure factor of neutron diffraction of a liquid metal. The dynamical effect of the electron-ion interaction is investigated in reference to Ziman's plasma term scattering. The effect is shown to cause a mass shift for thermal properties of electrons and in the case of liquid sodium the mass shift is expected to amount to the same order as in the solid. (auth)

20629 (NP-13850) ÉTUDE EXPÉRIMENTALE DES ONDES DE CHOC PRODUITES PAR DÉCHARGES D'UN CONDENSATEUR DANS UN TUBE A GAZ (theses). (Experimental Study of the Shock Waves Produced by Condenser Discharge in a Gas Tube (thesis)). Roger Der Agobian (Paris. Université). [nd]. 65p.

The shock waves produced by condenser discharge in a gas tube were investigated. The study was limited to wave velocities less than five times the speed of sound, propagated in gas at low pressure (several mm Hg). A method was designed and perfected for the detection of the shock waves that are insufficiently rapid to produce gas ionization. This method consisted of the creation of an autonomous plasma, before the arrival of the wave, which was then modified by the wave passage. Two methods were used for the detection of phenomena accompanying the passage of the shock waves, an optical method and a radioelectric method. The qualitative study of the modifications produced on the wave passage showed the remarkable correlation existing between the results obtained by the two methods. The experimental results on the propagation laws for shock waves in a low-diameter tube agreed with theory. The variations of the coefficient of recombination were determined as a function of the electron temperature, and the results were in good agreement with the Bates theory. It was shown that the electron gas of the plasma had the same increase of density as a neutral gas during the passage of a shock wave. The variations of the frequency of electron collisions on passage of the shock wave could be explained by considering the electron–ion collisions with respect to electron–atom collisions. (J.S.R.)

20630 (NYO-10436) MODERATELY STRONG OBLIQUE SHOCKS AND SIMPLE WAVES IN STEADY MAGNETOHYDRODYNAMIC FLOW. Y. M. Lynn (New York Univ., New York. Courant Inst. of Mathematical Sciences). Feb. 14, 1964. Contract AT(30-1)-1480. 66p.

Steady two-dimensional magnetohydrodynamic flow for the general case of nonaligned flow and magnetic field directions, as well as of arbitrary strength of magnetohydrodynamic interactions, is considered. An explicit solution describing the physical state across either a family of simple waves or an oblique shock of moderate strength is obtained. It is derived by expansion of the jump conditions of the state variables across an oblique magnetohydrodynamic shock up to second order with respect to the shock strength that is measured by θ, the deflection angle of the flow direction across the wave. The solution corresponds to a correction of linear characteristics solution for small disturbances. It is shown, to the present approximation, that the position of an oblique magnetohydrodynamic shock bisects the angle made by upstream and downstream characteristics. Simple solutions for different limiting cases are given. A singularity of the expansion is exhibited and investigated in detail. (auth)

20631 (SC-DC-64-420) FUNDAMENTAL CATHODE MECHANISMS IN A METAL VAPOR ARC. Report No. 7. Final Report, March 1, 1962–September 30, 1963. E. M. Boone (Ohio State Univ. Research Foundation, Columbus). Nov. 1963. For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 127p.

Some of the properties of the vacuum arc were investigated in the hope of finding information that would lead to a clearer understanding of this phenomenon. Three specific areas were investigated. The stability of low-current, overvolted vacuum arcs was studied by means of natural lifetime and induced extinction experiments. The minimum burning voltages of vacuum arcs were measured between parallel contacts closing in vacuum. High resolution autoradiographic techniques were used to determine the transfer of electrode material during the initiation of a vacuum arc. These investigations showed that the extinction time of overvolted vacuum arcs between Cu, Al, Ti, and W electrodes is less than 5×10^{-8} seconds, and that the lifetime characteristics of overvolted arcs are similar to those of drawn arcs. Minimum burning voltages and approximate cathode and anode fall potentials were obtained for arcs between Cu, Al, Ni, Ti, Ag, and Au electrodes. Clumps of anode material were found on the cathode as well as on the insulator separating the electrodes. (auth)

20632 (TID-18689) NMR STUDIES OF ADSORPTION OF METAL OXIDES. Wallace S. Brey, Jr. and Kenneth D. Lawson (Florida. Univ., Gainesville). [1962]. Contract [AT(40-1)-2664]. 21p.

NMR relaxation measurements have been employed to study the behavior of adsorbed molecules. Proton resonance measurements do not generally permit a distinction between hydrogen atoms in various molecular environments in an adsorbate because the line widths are as great as the relative chemical shifts. However, temperature dependence studies of the line widths of alcohols and amines adsorbed on thorium oxide show that different kinds of protons lose motional freedom at different temperatures. At higher temperatures there is found a narrow line produced by all the protons in a molecule. At intermediate temperatures there is observed a broader line which consists of a narrow component for the freely rotating part of the molecule and a broad component for the protons in the polar group. At lower temperatures, the latter component becomes too broad to observe under normal operating conditions and only the quite narrow line of the alkyl group is found. At still lower temperatures, the latter may broaden as molecular motion slows. Chemical shift differences of fluorine atoms are larger than those for hydrogen atoms. Consequently, the line broadening of the individual bonds for the various groups in perfluoropropylene adsorbed on alumina can be observed. (auth)

20633 (TID-20512) IRREVERSIBLE STATISTICAL MECHANICS OF MODERATELY DENSE FLUIDS. Raiph J. Nossal (Michigan. Univ., Ann Arbor. Coll. of Engineering). July 1963. Contract AT(11-1)-917. 174p. (ORA-03712-6-T)

Primary attention is given to the calculation of time-relaxed probability densities and associated correlation functions for particles moving through an equilibrium assembly of like particles. An integro-differential equation describing the temporal evolution of the probability densities is obtained from the Liouville equation. In contrast to the BBGKY hierarchy, the derived equation contains all the information necessary for its solution; i.e., the kinetic equation for a reduced probability density does not contain integrals over unknown higher order densities. The kinetic equation for the one-particle density is studied in detail. An expansion for the collision integral appearing in this equation is obtained such that effects of interparticle forces are represented by terms of increasingly higher order. Collision integral terms through the "fourth power of the forces" are obtained explicitly. Solution of the kinetic equation is obtained by an iteration procedure in which the zeroth-order terms are those which would be the only ones appearing were the assembly an ideal gas. Higher order terms are coupled with constants which are, effectively, increasingly higher powers of the ratio of potential to kinetic energy of the assembly. The time-relaxed momentum density is obtained from the full probability density by integrating over spatial coordinates. Corresponding expansions are obtained, also, for some related correlation functions (e.g., the momentum autocorrelation function). An expansion for the "self" part of the spatial two-time density $G_s(r,t)$, is also found in direct correspondence with the expansion obtained for the full μ-space density. The general functional form of this expression is derived and explicit evaluation is made of the low order terms of the expansion. By taking Fourier transforms with respect to space and time, expressions are obtained for the classical "scattering functions" for incoherent scattering of slow neutrons. Corrections for the purpose of obtaining the proper quantum mechanical scattering functions are discussed. Bogoliubov type equations are also investigated in order to obtain kinetic equations pertinent to a density expansion of the one particle probability function. Methods previously developed for model systems interacting solely through repulsive forces are extended to systems for which attractive terms are also present in the interparticle potentials. The asymptotic collision integrals present in the kinetic equation appear as coefficients of a double expansion in c and ϵc, where c is the density, and ϵ is a coupling constant related to the ratio of potential to kinetic energies of the assembly. Approximate expressions for the two-particle probability density, consistent with the assumptions employed in the derivation of the kinetic equation for the one-particle density, are also derived. Investigation of the "distinct" part of the two-time spatial density, $G_d(r,t)$, was initiated. A relationship between the "convolution approximation" for $G_d(r,t)$ and the superposition approximation for the two-particle density is explicitly demonstrated. 52 references. (auth)

20634 (UCRL-7177) PREDICTING TIME-OF-BURST OF EXPLODING WIRES FROM THERMODYNAMIC AND ELECTRICAL PROPERTIES. R. C. Maninger (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 7, 1963. Contract W-7405-eng-48. 20p. (CONF-24-22)

From the 4th Symposium [on] Engineering Aspects of Magnetohydrodynamics, Berkeley, Calif., Apr. 1963.

A method of predicting the upper bound of the time-of-burst from known thermodynamic and electrical properties of the wire material is presented. The measurement of time-of-burst can yield information on properties of the material at high temperatures. The method consists of determining "transformation time integrals" of the form of "action integrals" that have been empirically observed in exploding wire work. In cases where enough thermodynamic data are available, the computed transformation time integral numerically agrees with observed action integrals within a few percent. (auth)

20635 (UCRL-7205-T) A TENSOR ARTIFICIAL VISCOSITY FOR NUMERICAL HYDRODYNAMICS. William D. Schulz (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 1963. Contract [W-7405-eng-48]. 17p.

Arguments are presented to the effect that a tensor artificial viscosity is a more suitable quantity to use than the usual scalar viscosity. A specific tensor viscosity is constructed for the case of a two dimensional Lagrangian system. (auth)

20636 (UCRL-7286-T(Pt.2)) IONIZATION EQUILIBRIUM AT HIGH DENSITIES. II. APPLICATION TO HIGH Z MATERIAL. Carl A. Rouse (California. Univ., Livermore. Lawrence Radiation Lab.). May 1963. Contract W-7405-eng-48. 9p.

The formulation of pressure ionization is extended to high-Z materials. Results are presented for iron covering a density range of 0.1 g/cc to 10^8 g/cc. (auth)

20637 (UCRL-7290-T) AN EXPLANATION FOR THE EFFECT OF FERROMAGNETISM UPON ATOMIC DIFFUSION. R. J. Borg (California. Univ., Livermore. Lawrence Radiation Lab.). May 1, 1963. Contract W-7405-eng-48. 11p.

The diffusion coefficients of almost every ferromagnetic material that has been studied deviate from the Arrhenius relation over a wide temperature range centered around the Curie temperature. The original explanation in terms of a decrease in the equilibrium concentration of vacant lattice sites is reviewed, and an alternative explanation in terms of the unusual temperature dependence of elastic properties is presented, based on recent data. It appears likely that the Arrhenius relation may be applicable, if at all, only at temperatures much higher or lower than T_c. Seeming support for the Zener model of diffusion is also noted. (D.C.W.)

20638 (UCRL-7347) PRODUCTION OF TRANSURANIUM ELEMENTS IN A THERMONUCLEAR EXPLOSION—ANACOSTIA. R. W. Hoff and D. W. Dorn (California. Univ., Livermore. Lawrence Radiation Lab.). May 2, 1963. Contract W-7405-eng-48. 5p.

A summary is presented of the results obtained in a radiochemical investigation of the debris in fused rock from the Anacostia underground explosion on Nov. 27, 1962. The relative yields of the actinides of mass numbers 239 to 254 (Np to Cf) are tabulated, and the mass-yield curve is compared with that of the Mike event. (D.L.C.)

20639 EVALUATION AND ANALYSIS OF THRUST UNITS FOR POWER-LIMITED PROPULSION SYSTEMS. R. D. Shelton, R. A. Potter, L. Lacy, and E. Stuhlinger (George C. Marshall Space Flight Center, Huntsville, Ala.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 682-5(Apr. 1964).

Performance parameters of power-limited propulsion

systems are expressed formally in terms of the kinematic properties of thrust units. Ion engine deficiencies, such as neutral efflux, multiple ionization, and propellant stream divergence, are described as velocity distributions in the exhaust stream and are related algebraically to the important mission parameters. The relative importance of these deficiencies is therefore determined in the framework of the mission. The discussion provides a background for the selection of the best set of physical measurements to be made for the evaluation of thrust units and shows how these measurements are related to the mission parameters. (auth)

20640 ELECTRICAL AND SPECTROSCOPIC STUDY OF D-C DISCHARGES IN HELIUM UNDER PRESSURE. Yvonne Leycuras (Centre National de la Recherche Scientifique, Paris). Ann. Phys. (Paris) (13), 8: 577-610(Sept.-Oct. 1963). (In French)

The results of an oscillographic and spectroscopic study of low-intensity, d-c discharges in helium under pressures of 1 to 100 atmospheres are presented and interpreted. Emission from the gas, such that the interaction of excited atoms could be studied as a function of density, was sought. (D.C.W.)

20641 DESORPTION OF CO AND O^+ FROM POLYCRYSTALLINE Mo SURFACES BY SLOW ELECTRON IMPACT. P. A. Redhead (National Research Council, Ottawa). Appl. Phys. Letters, 4: 166-7(May 1, 1964).

Electronic desorption of carbon monoxide from Mo surfaces at 300°K was measured with normally incident electrons of 0 to 300 ev. The ion yield from a fully covered surface had a maximum value of 3×10^{-7} ion/electron at 100 ev, and mass spectrometric observations showed that only O^+ was released. The cross sections were measured for ions and neutrals. (R.E.U.)

20642 BOUNDARY LAYER ON A PLANE IN ANISOTROPIC MAGNETOHYDRODYNAMICS. V. B. Baranov, A. G. Kulikovskii, and G. A. Lyubimov. Izv. Akad. Nauk SSSR, Mekhan. i Mashinostr., No. 1, 141-2(Jan.-Feb. 1964). (In Russian)

Calculations are made of a boundary layer with a constant temperature in the presence of a current of Larmor rotating electrons. The problem of external flow perturbation by the boundary layer was analyzed. It is shown that with Blazue's velocity profile it is possible to reduce the disparity $M^2 \lesssim R$ to $M^2 \lesssim R^{\frac{1}{2}}$. The results are given for a thermal boundary layer calculated considering the Ettinghausen effect. (R.V.J.)

20643 MAGNETO-ACOUSTIC WAVES THROUGH AN ELECTRICALLY CONDUCTING MEDIUM IN THE PRESENCE OF A MAGNETIC FIELD. Yoshihito Takesada (Kyoto Gakugei Univ.). J. Geomagnet. Geoelec., 15: 173-5 (1964).

It is found that the pressure amplitude of a magneto-acoustic wave is heavily attenuated for shorter wavelengths, and consequently the magnetic field which is caused by the sound waves depends on the wavelength of the sound. See also NSA 18: 9519. (R.E.U.)

20644 EDGE EFFECT IN CHARGED-PARTICLE ANALYZING MAGNETS. C. M. Braams (Rijks Universiteit, Utrecht and FOM-Instituut voor Plasma-Fysica, Jutphaas, Netherlands). Nucl. Instr. Methods, 26: 83-9(Feb. 1964).

The manner in which local saturation of pole pieces with sharp edges affects the fall-off of the magnetic induction in the fringing-field region is discussed and measured. Local saturation appears to set in at a field strength well below that at which overall saturation of the pole pieces becomes noticeable. The resulting change in the calibration of a uniform-field sector magnet is discussed. A pole shape is proposed in which the magnetization is uniform and it is shown experimentally that no edge effect occurs with such poles. (auth)

20645 ON A CIRCULARLY SYMMETRIC MAGNETIC FIELD. L. A. C. Koerts (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Instr. Methods, 26: 152-6 (Feb. 1964).

This note discusses orbits in a plane where a magnetic field is perpendicular to the plane and satisfies the equation $B(r,\phi) = B(r)$ for $r < R$ and $B = 0$ for $r \geq R$. The existence of orbits that run into the field region radially, leave the field region radially, and also include the symmetry center, is proved for all particle momenta larger than a critical value. The presence of the symmetry center in the orbits results from the equation div B = 0 and the symmetry of the field. A specific application (i.e., as a rotator of angular distributions) is discussed. (auth)

20646 APPROXIMATE RELATIVISTIC EQUATIONS OF MOTION FOR AN EXTENDED CHARGED PARTICLE IN AN INHOMOGENEOUS EXTERNAL ELECTROMAGNETIC FIELD. P. Nyborg (Agricultural Coll. of Norway, Vollebekk). Nuovo Cimento (10), 31: 1209-28(Mar. 16, 1964).

Classical expressions for the external force and torque in the mass-of-center frame including first-order terms in the electromagnetic field are given. Electric and magnetic dipole momentum vectors are introduced. A relativistic generalization of the classical procedure is performed, using a projection tensor that separates out the proper space part of four-vectors and four-tensors. A covariant electromagnetic moment tensor is introduced. In the case of no electric moment in the proper mass-of-center frame, the electromagnetic moment tensor is substituted by a magnetic moment pseudovector. (auth)

20647 PROPAGATION OF SHOCK WAVES IN A HYDRODYNAMIC CONICAL SHOCK TUBE. William S. Filler (Naval Ordnance Lab., White Oak, Silver Spring, Md.). Phys. Fluids, 7: 644-7(May 1964).

Hydrodynamic shock waves were generated in a conical sector shock tube (7°) driven by a $\frac{1}{2}$g high explosive charge situated at its vertex. Pressure–time histories of the shock waves were obtained with piezoelectric instrumentation. The shape and decay properties of the wave as it progressed down the tube were similar to those of a spherical shock wave generated in free water by a $\frac{1}{4}$-lb sphere of TNT. The effect of the sector tube in concentrating the explosive energy within a small solid angle is defined by the expression $W = Kw \sin^{-2}(\frac{1}{2}\alpha)$, where W is the effective weight of charge, w the actual weight of charge used, α the cone half angle, and K an energy loss constant. This type of shock tube greatly facilitates the study of explosion hydrodynamic shock waves and their interactions. These results parallel earlier results for a gasdynamic conical shock tube. (auth)

20648 STABILITY OF IDEALIZED ONE-REACTION DETONATIONS. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 7: 684-96(May 1964). (LADC-6109)

The hydrodynamic stability of steady, one-dimensional detonations in an ideal-gas medium, undergoing the irreversible, unimolecular reaction A → B, having Arrhenius rate constant, is obtained in numerical form by application of the general theory of detonation stability. Stability results, as well as the pressure and progress variable pro-

files for the steady detonations, are presented for a (constant) heat capacity ratio γ of 1.2, a heat of reaction Q, relative to thermal energy in the cold reactants, of 50, activation energies Q- (in the same units) of 10 and 50, and at several detonation velocities, D. The neutral stability curves, consisting of the values of the disturbance wave length transverse to the steady flow for which the steady detonation of given velocity changes stability (as functions of detonation velocity), are investigated. One-dimensional disturbances are found to be unstable at low detonation velocities (i.e., near the CJ point), for the larger activation energy (but not the smaller) but are stabilized by sufficient overdrive. At fixed detonation velocity, a range of wave lengths are unstable and for Q- = 50, this instability appears to persist for all detonation velocities. For decreasing heat of reaction (at fixed Q-, γ, and D/D_{CJ}) the detonation is found to become stable although for Q- = 50 the instability persists to very small values of the heat of reaction. Thus, the system Q = 0.3, Q- = 50, γ = 1.2 is found to be unstable when $f = (D/D_{CJ})^2 \leq 1.1$. The phenomenon of one-dimensional instability and its dependence on Q is also investigated. (auth)

20649 STABILITY OF PLANE MAGNETOHYDRODYNAMIC SHOCKS. C. S. Gardner and M. D. Kruskal (Radio Corp. of America, Princeton, N. J.). Phys. Fluids, 7: 700-6(May 1964).

The stability of plane magnetohydrodynamic shocks in a perfectly conducting fluid with general equation of state is studied. General (three-dimensional) perturbations are considered. A condition for stability is derived for the special case of perpendicular and parallel fast shocks. Stability is thereby proved in these cases for a polytropic gas with $\gamma < 3$. (auth)

20650 LINEARIZED HYPERBOLIC STEADY MAGNETOHYDRODYNAMIC FLOW PAST NONCONDUCTING WALLS. C. K. Chu (Columbia Univ., New York). Phys. Fluids, 7: 707-14(May 1964).

Linearized steady hyperbolic flows of an ideally-conducting fluid past infinite insulating walls are considered. Because of the interaction between the magnetic fields in the fluid and in the solid wall, the fluid is everywhere disturbed and there are no regions of uniform flow. The flow cannot be constructed from shocks and simple waves as in ordinary supersonic gas dynamics, but must be found together with the field in the solid. Essentially, the linearized problem consists of a wave equation in the upper half-plane, and a Laplace equation in the lower half-plane, with appropriate boundary conditions on the interface and at infinity. A general procedure which yields the unique solution is given. Several specific examples are calculated, including the flow past a wavy wall, and the flow past a wall with two corners. It is shown that the flow past a single corner is not a meaningful problem, since the perturbations become infinite far away from the corner. (auth)

20651 ONE- AND TWO-DIMENSIONAL PROPAGATION OF ALFVÉN WAVES IN INHOMOGENEOUS MAGNETIC FIELDS. Guenther Plato (Loockheed-California Co., Burbank). Phys. Fluids, 7: 715-22(May 1964).

It is shown that in an infinitely soft medium where the sound speed is small against the Alfvén speed one-dimensional propagation along a field line with finite curvature is possible only if the gradient of the Alfvén speed in the direction of the principal normal vanishes on that line. However, waves spreading two-dimensionally over certain surfaces always exist. Conditions are derived that the existing waves are without dispersion. (auth)

20652 RESONANT FREQUENCIES OF AN ELECTROMAGNETIC CAVITY IN AN ACCELERATED SYSTEM OF REFERENCE. C. V. Heer (Ohio State Univ., Columbus). Phys. Rev., 134: A799-804(May 18, 1964).

The resonant frequencies of an electromagnetic cavity in a nonpermanent gravitational field such as that provided by rotation are considered. The constitutive equations for accelerated macroscopic matter are developed, and it is shown that the electromagnetic-field tensors are related by $H_{xt} = K_c F_{xt}$ and $K_m H^{xy} = F^{xy}$, etc. For the special case of angular rotation about the z axis, the constitutive equations are given in terms of noncovariant field vectors B, H, D, E. Maxwell's equations are solved using these constitutive equations and it is shown that the degeneracy between the axially degenerate modes, i.e., clockwise and and counter-clockwise traveling waves, is removed by the rotation. In vacuum a shift in frequency of $\Omega \cdot J/h$ or a splitting between traveling wave modes of $2\Omega \cdot J/h$ is predicted from the similarity between energy flux and momentum. This led to a suggestion of the "Coriolis-Zeeman" effect for photons. Using either the above development or the energy density, it is shown that the effect depends on the moment of the energy flux and is only proportional to the angular momentum. In the geometrical-optics region an index of refraction valid for accelerated macroscopic matter is developed and is applied to the square Fabry-Perot cavity rate gyroscope to yield the same result as either of the above methods. An experiment to show the validity of Minkowski's decomposition of the energy-momentum tensor is discussed. (auth)

20653 PRECISION EVALUATION OF THE HIGH-FREQUENCY LIMIT OF THE CONTINUOUS X-RAY SPECTRUM USING A GAS TARGET X-RAY TUBE. Jon J. Spijkerman and J. A. Bearden (Johns Hopkins Univ., Baltimore). Phys. Rev., 134: A871-6(May 18, 1964).

The major uncertainty in previous measurements of the high-frequency limit of the continuous x-ray spectrum was due to the fine structure associated with the observed cutoff. The development of a high-power mercury vapor target x-ray tube permitted observations to be made under idealized thin-target conditions. The x-ray intensity near the high-frequency limit was comparable to that of a solid target x-ray tube. The x-ray intensity was measured as a function of the voltage applied across the tube, with a double-crystal monochromator adjusted for the 1.537400 kxu wavelength of the Cu $K\alpha_1$ line. The absence of fine structure in the observed isochromat greatly increased the accuracy in the determination of the voltage cutoff. Accurate measurements of this voltage yielded a voltage-wavelength conversion factor $V\lambda_8 = (12372.26 \pm 23$ ppm) xu-volts. Using h/e from non x-ray data, the x-ray wavelength conversion factor from x units to cm (or angstroms) can be calculated, or conversely h/e evaluated. The effects of a revision in the Cu $K\alpha_1$ wavelength are also discussed. (auth)

20654 PULSED SOURCE OF TRITIUM IONS. A. S. Knyazyatov, V. V. Maltsev, and G. A. Otroshchenko. Pribory i Tekhn. Eksperim., No. 1, 196-7(Jan.-Feb. 1964). (In Russian)

Results of the measurement of the tritium ion yield as a function of time from a pulsed source with occluded tritium are presented. The ion yield was determined by measuring the neutron velocity from a deuterium target. (tr-auth)

20655 A SOLUBLE MODEL OF A CLASSICAL IMPERFECT GAS IN A VESSEL. H. N. V. Temperley (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 83: 565-70(Apr. 1964).

A natural extension of the Gaussian model of an imperfect gas permits an exact description of such a gas in a vessel. The conclusion of a former paper that the virial curve extends smoothly to infinite density is confirmed, but it is shown that this fact does not rule out the possibility of a phase transition. A preliminary study suggests that this model would have a transition to an ordered arrangement of molecules, similar to that of the rigid sphere model. Although continuous, this model shares several analytic properties with models of "lattice" type. (auth)

20656 TEMPERATURE DEPENDENCE OF VACANCY PRODUCTION BY X RAYS IN POTASSIUM IODIDE. T. P. P. Hall, D. Pooley, and P. T. Wedepohl (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Proc. Phys. Soc. (London), 83: 635-43(Apr. 1964).

The x-ray coloration of KI, in particular the growth of the F band, was investigated at a series of temperatures below room temperature. It is found that the slow rate of growth of the F band, and the qualitative features of the absorption spectra of irradiated crystals, are sample dependent even at liquid helium temperature. The rate of growth of the F band is found to be very temperature dependent, showing a very rapid rise near 90°K and reaching a maximum between 90 and 195°K. This is explained in terms of a model based on the interaction of pairs of singly ionized anions. (auth)

20657 AN APPROXIMATION METHOD FOR DIFFRACTION PROBLEMS. K. M. Case (Massachusetts Inst. of Tech., Cambridge). Rev. Mod. Phys., 36: 669-79(Apr. 1964). (TID-20265)

An approximation method to be used where a numerical integration is performed over a large restricted region of space is explained. Two examples are treated: (1) diffraction by a large slit or strip, where an incident plane wave is given and Dirichlet or Neumann boundary conditions are satisfied; (2) diffraction by a circular disk or aperture. (M.J.T.)

20658 THE THEORY OF SPHERICALLY SYMMETRIC SPACE-TIME. Hyoitiro Takeno (Hiroshima Univ.). Sci. Rept. Res. Inst. Theoret. Phys., Hiroshima Univ., No. 3, 1-287(1963).

Space-time is considered as a geometric entity independent of the special choice of the coordinate system, and its spherical symmetry is discussed as an intrinsic property. A comprehensive summary is presented of 18 of the author's past papers. The classical definition of a spherically symmetric space-time and that of a spherically symmetric object are introduced. A definition of a spherically symmetric space-time from the standpoint of the theory of invariants is introduced by using some scalars and vectors characterizing the space-time. The groups of motions and those of conformal transformations in spherically symmetric space-times are determined completely, and from the standpoint of these groups, the space-times are classified invariantly in terms of their characteristic systems. The problem of imbedding a spherically symmetric space-time in a flat space of higher dimension and that of conformal correspondence of spherically symmetric space-times are discussed. The general forms of form-invariant geometric quantities under each group of motions and those of parallel (or equivalently, constant) tensors are determined. Spherically symmetric space-times with corresponding geodices are dealt with, and a method of generalizing the results obtained to an n(≥5)-dimensional case is given. The concept of "staticness" of a spherically symmetric space-time is introduced as an intrinsic property of the space-time, and the many-body problem is approached in this way. The space-time of relativistic cosmology is discussed. 38 references. (R.E.U.)

20659 PROBLEMS ON CONDUCTING FLUID FLOW IN A PLANE CHANNEL. A. E. Yakubenko. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 7-12(Nov.-Dec. 1963). (In Russian)

Two problems on conducting fluid flow in a plane channel were resolved using Winer-Hopf methods. Motion of a semi-infinite plate in a conducting fluid, confined between two parallel planes in a transverse magnetic field was analyzed in the first problem. Flow between parallel half-dielectric and half-ideally conducting walls was analyzed in the second problem. (tr-auth)

20660 CONDUCTING FLUID IN A PLANE MAGNETOHYDRODYNAMIC CHANNEL. E. P. Zimin (Krzhizhanovskii Inst. of Power Engineering, [Moscow]. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 108-12(Nov.-Dec. 1963). (In Russian)

An analysis was made of viscous incompressible anisotropically conducting fluid flow in a magnetohydrodynamic channel in which the field intensity vector is found between parallel conducting plates. (R.V.J.)

20661 PRE-ELECTRODE POTENTIAL VARIATIONS IN WEAK CURRENT PASSAGE THROUGH IONIZED GAS. G. A. Lyubemov. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 146-8(Nov.-Dec. 1963). (In Russian)

The nonlinear volt-ampere characteristics of a gas with an applied potential difference were calculated considering pre-electrode layers in an ionized flow in a magnetic field. (R.V.J.)

20662 ON CERTAIN PROPERTIES OF ELECTRIC ARC BURNING IN DIRECT CURRENT PLASMATRONS. V. Ya. Smolyakov. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 148-53(Nov.-Dec. 1963). (In Russian)

A d-c plasmatron with a whirl stabilized arc was used to show continuous variations in arc length, intensity, and current induced when the positive column runs along the electrode axis. Under certain conditions, arc oscillations reached 40 to 50% of the mean value. The mechanism of the mean arc intensity in a plasmatron and the effects of electrode polarity on arc intensity are analyzed. (R.V.J.)

20663 RESONANCE HIGH FREQUENCY ELECTRIC DISCHARGE AND THE POSSIBILITIES OF DEPRESSING IT. B. A. Zager and V. G. Tishin. Zh. Tekhn. Fiz., 34: 297-306(Feb. 1964). (In Russian)

The mechanism of direct current influence on high-frequency discharge is described. The boundary relations are developed for a high-frequency resonance discharge as functions of oscillation frequency and the distance between electrodes. Means for depressing resonance discharge are discussed. (tr-auth)

20664 SPHERE ROTATION IN LARGE REYNOLDS' NUMBER VISCOUS CONDUCTING FLUID IN MAGNETIC FIELD. G. Z. Gershuni and E. M. Zhukhovitskii (Perm State Univ., USSR and Perm State Pedagogical Inst., USSR). Zh. Tekhn. Fiz., 34: 336-9(Feb. 1964). (In Russian)

The problem of a rapidly rotating sphere in a viscous conducting fluid with a large Reynolds number and a boundary layer was resolved for the case in which the magnetic number is small and the induced field is smaller than the external. The distribution of induced currents in the sphere was found, and an integral method was used for determining boundary layer parameters and the retarding moment. (R.V.J.)

20665 ON THE PROBLEMS OF ELECTRIC PROBES IN A HIGH VACUUM. A. I. Akishin and Yu. A. Doktorov

(Moscow State Univ.). Zh. Tekhn. Fiz., 34: 352-3(Feb. 1964). (In Russian)

Preliminary data are given on pulsed charged particle emission resulting from electrode bombardment in a vacuum and acted upon by an electric field. The experimental installation is described. A graph of the mean number of charged particles (N) (ions and electrons) produced as a function of electric potential in a discharge interval indicates $N \gg 10^5$ to 10^6. It is postulated that ions and electrons are formed in a microdischarge at the expense of adsorbed residual gas ionization. (R.V.J.)

20666 INVESTIGATION OF ENERGY DISTRIBUTION OF NICKEL ATOMS FORMED IN NICKEL CATHODE SPUTTERING BY MERCURY IONS. M. B. Ben'yaminovich and V. I. Veksler. Zh. Tekhn. Fiz., 34: 361-8(Feb. 1964). (In Russian)

The distribution of neutral particles passing through a low-pressure mercury arc plasma was studied and the ions formed were analyzed. The neutral flux produced by nickel bombardment with 200 to 800 ev mercury ions was investigated and the energy distribution of sputtered nickel atoms was found at w > 10 ev energies. The relative number of fast atoms and the atom energy increase with increasing bombarding ion energy were found. The relation between sputtered particle flux and target temperature was investigated. (tr-auth)

20667 MEISSNER EFFECT AND FLUX QUANTIZATION IN THE QUASIPARTICLE PICTURE. Dietrich Albert Uhlenbrock. Thesis, New York, New York Univ., 1963. 111p.

Bogolyubov's treatment of a self-interacting many-fermion system by the generalized canonical quasiparticle transformation is extended to the case of nonzero temperature. The thermodynamic features of the model are introduced via the assumption that the statistical operator of the system describes free quasiparticles. The thermodynamic grand potential is expressed in terms of the variational parameters contained in the generalized canonical transformation and the statistical operator. The minimum principle for the thermodynamic grand potential is used in order to determine the optimal quasiparticle set. The basis equations of the model are derived by requiring the grand potential to be stationary with respect to first order changes of the variational parameters. These equations can be reformulated, so that the canonical transformation simultaneously diagonalizes the generalized density and energy matrices. The reformulated basic equations are solved for a general velocity-independent two-particle potential in the absence of a magnetic field. To study the behavior of the system in an external magnetic field, the basic equations are linearized by considering the first order changes with respect to the basic solution due to a general magnetic vector potential. The discussion of the Meissner effect is reduced to the examination of a linear inhomogeneous system of equations. The quantization of the flux threading a doubly connected superconductor is studied through the stylized model of a cubic geometry with periodicity in the direction corresponding to the angular periodicity in the doubly connected case. (Dissertation Abstr., 24: No. 8, Feb. (1964))

20668 COLOR CENTERS PRODUCED IN KCl AND KBr BY PROLONGED X-IRRADIATIONS AT LOW TEMPERATURES. Bruce John Faraday. Thesis, Washington, D. C., Catholic Univ. of America, 1963. 138p.

Studies were made on the effects of x irradiation of extended duration on the production of color centers in KCl and KBr at low temperatures and possible implications with regard to suggested color center models were examined. An additional problem undertaken was to conduct a search for M centers by x-ray production at low temperatures. Thin plates of KCl and KBr single crystals were exposed to x rays at low temperatures for prolonged times (approximately 60 hours). Irradiations were interrupted periodically for measurements of optical absorption spectra between 200 mμ and 1.5 μ without intervening warm-up. Growth curves were determined at 18°K for the F, K, M, and H bands in addition to a new band observed at 245 mμ in KCl and 278 mμ in KBr called the H′ band. Likewise, growth curves were observed for the F, K, M, V_2 and V_4 bands at 80°K. The F to K ratio was found to remain constant indicating that both of the bands arise from transitions in the same center. The concentration of M centers was found to depend quadratically on the F-center concentration. This result gives conclusive support that the M center consists of a pair of associated F centers rather than a vacancy pair plus a single F center. The F to H ratio was observed to be constant for short x irradiations supporting the viewpoint that the two centers are produced as complementary defects; however, for prolonged exposures this constant ratio is no longer maintained. The number of F centers is in constant ratio to the combined concentrations of H and H′ centers provided that the oscillator strength of the H′ band is suitably chosen. The linear dependence of the generation of both H_4 centers in KBr and V_4 centers in KCl on F-center concentration suggests that V_2 and V_4 centers, rather than V_1 centers, are fundamentally related to the mechanism of formation of F centers near liquid nitrogen temperature for a prolonged irradiation. (Dissertation Abstr., 24: No. 9, March, 1964)

20669 MEASUREMENTS OF ELECTRON CASCADES IN LEAD USING A BUBBLE CHAMBER. H. Lengler. Thesis, Aachen, Technische Hochschule, 1962. 66p. $2.00(Gmelin, AED-DISS. 62-677). (In German)

Electron-photon cascades were studied with a bubble chamber using electrons with energies of 380, 200, and 100 Mev from an electron synchrotron. The number of showers was large enough to permit determination of angular distributions. Results indicate that the importance of multiple scattering in lead is underestimated in all existing theories. (Gmelin Inst.)

20670 STUDIES OF ELASTIC AND INELASTIC ELECTRON SCATTERING WITH THIN FOILS. H. Miessner. Thesis, Berlin, Technische Hochschule, 1963. 57p. $2.00 (Gmelin, AED-DISS. 63-319). (In German)

A reverse potential energy analyzer for the measurement of energy and angular distributions in electron diffraction diagrams using a scintillator and photomultiplier is described. Minimum current is 10^{-17} amp for a time constant of 1 sec. Elastic background scattering in diffraction diagrams was measured with poly- and monocrystalline Ag and mica foils of equal thickness. Poly- and monocrystalline silver have the same background intensities. Elastic background in mica is approximately one order of magnitude lower. Angular dependence of the 14.7-ev energy loss in Al is in agreement with theoretical data based on plasma theory. (Gmelin Inst.)

20671 COMPTES RENDUS DE LA VI^e CONFÉRENCE INTERNATIONALE SUR LES PHÊNOMÉNES D'IONISATION DANS LES GAZ, PARIS, 8-13 JUILLET 1963. VOLUME II. (Proceedings of the VIth International Conference on Ionization Phenomenon in Gas, Paris, July 8-13, 1963.

Volume II). P. Hubert and E. Crémieu-Alcan, eds. Paris, SERMA, 1963. 647p.

The topics discussed include cathode emission, sputtering, ion ranges in crystals, electric discharge phenomena, ionization phenomena, pinch discharge, plasma containment, electric discharge equipment, and exploding wire phenomena. Separate abstracts have been prepared for 119 of the 124 papers presented. Abstracts of 5 papers previously appeared in NSA (17: 8624, 9744, 16854, 29658, and 32734). (C.E.S.)

For abstracts of individual papers see: 20013, 20136, 20137, 20138, 20139, 20140, 20141, 20142, 20143, 20144, 20145, 20146, 20147, 20148, 20149, 20150, 20151, 20152, 20153, 20154, 20155, 20602, 20672, 20780, 20781, 20782, 20783, 20784, 20785, 20786, 20787, 20788, 21451, 21452, 21453, 21454, 21455, 21456, 21457, 21458, 21459, 21460, 21461, 21462, 21463, 21464, 21465, 21466, 21467, 21468, 21469, 21470, 21471, 21472, 21473, 21474, 21475, 21476, 21477, 21478, 21479, 21480, 21481, 21482, 21483, 21484, 21485, 21486, 21487, 21488, 21489, 21490, 21491, 21492, 21493, 21494, 21495, 21496, 21497, 21498, 21499, 21500, 21501, 21502, 21503, 21504, 21505, 21506, 21507, 21508, 21509, 21510, 21511, 21512, 21513, 21514, 21515, 21516, 21517, 21518, 21519, 21520, 21521, 21522, 21523, 21524, 21525, 21526, 21527, 21528, 21529, 21530, 21531, 21532, 21533, 21534, 21535, 21536, and 21537.

20672 THE MEASUREMENT OF RANGES AND DEPTH DISTRIBUTION OF IONS IN THE KILOELECTRONVOLT ENERGY REGION IN METALS BY MEANS OF THE RADIOACTIVE TRACER TECHNIQUE. B. Perović and T. Jokić (Inst. of Nuclear Sciences "Boris Kidrič." Belgrade). p.15-19 of "VI[e] Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Observations were made of the ranges and depth distribution of Xe ions in the crystal lattice of Cu, Ni, and Mo. The radioactive tracer technique was used. The metal targets were bombarded by ions of the radioactive Xenon-131 with the energy of 5, 15, and 30 kev. The depth penetration and distribution of ions were determined by the measurement of the residual target activity after successive removal of very thin target layers by means of the chemical etching technique. The quantity of the material dissolved in every layer was determined by a spectrophotometer, and the remaining activity was measured by the standard radioactive counting technique. From these data the depth distribution curves and the ranges of the ions in the bombarded targets were evaluated. The results were compared with existing theoretical estimates. (auth)

20673 ADVANCES IN SPACE TECHNOLOGY. Proceedings of a Symposium held at Hatfield College of Technology, Hertfordshire. J. L. Nayler, ed. London, George Newnes Ltd., 1962. 223p. 45s.

Present developments, satellite dynamics, space navigation, satellites for telecommunications, the re-entry problem, new materials for space, structural design of space vehicles, and human aspects of space flight are discussed. An extensive bibliography together with references on space flight are given. Detailed tabular information on all known space-vehicle launchings to Feb. 1962 is given. (R.E.U.)

20674 SOME ELECTRICAL PROPERTIES OF RADIOACTIVE CADMIUM SULFIDE FILMS IN VACUUM AND WITH ADSORBED HYDROGEN. Charles Lee Hearn. Thesis, Houston, Tex., Rice Univ., 1963. 279p.

The composition, bulk and surface electrical properties, and surface adsorption mechanism were examined in semiconducting CdS films through a technique of radioactive doping, which adds a known amount of an impurity to a semiconductor at a known rate. Electrical properties of thin CdS films on quartz substrates were studied in vacuum and in a H atmosphere. The films behaved as n-type semiconductors. Some of the films contained the radioactive isotope ^{35}S, which decays to ^{35}Cl. Electrical properties studied were conductance (dark value) and Seebeck effect. Measurements were made from 25 to 450°C over a period of several months. Conductance was found to be partially controlled by the contacts between the film crystallites and was sensitive to surface conditions. Seebeck effect was a bulk property and could be used to determine the position of the Fermi level and to calculate the conduction electron concentration. Three types of CdS films were studied: radioactive films containing ^{35}S, nonradioactive films, and nonradioactive films irradiated externally with ^{35}S β rays. Nonradioactive films had relatively stable vacuum electrical properties with only small changes in conductance and Seebeck effect. Externally irradiated films showed an increase in conductance of about one order of magnitude in 3 months. Radioactive films showed a conductance increase of over 2 orders of magnitude in 3 months. Seebeck measurements indicated that this increase was due almost entirely to the addition of current carriers donated by the Cl. Electrical measurements were made as H absorbed on the film. The Seebeck effect did not change, but the conductance always rose slightly on adsorption. It was found that there was no large order of magnitude effect on the rate of ionized adsorption caused by either the Cl impurities (as a chemical species) or the β flux. The rate of ionized adsorption appeared to be lower by about 20 to 50% on films with high Fermi levels. The lowest rate was observed on a radioactive film which had been allowed to decay for several months. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20675 ELECTRON SPIN DOUBLE RESONANCE STUDIES OF F-CENTERS IN KCl. Paul Richard Moran. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 212p.

The investigation of the F-center electron-spin-resonance spectrum in KCl at 300°K using a double frequency (DESR) technique is described. The inhomogeneously broadened resonance is saturated by an applied r-f pump field, and the spectrum is simultaneously probed by a weak detector field applied at a different frequency. The F-center concentration in the samples studied was $n_f \lesssim 3 \times 10^{17}$ cm^{-3}. The techniques used in obtaining the experimental data are discussed, and a theoretical treatment of the response of the spin system to 2 simultaneously applied r-f fields is developed. A relation between the area under the DESR signal and the intensity of the corresponding single frequency (ESR) absorption is derived. Application of the relation to experimental data gives a KCl F-center spin-lattice relaxation time at 300°K of $T_1 = 0.3 \times 10^{-4}$ sec, with an estimated uncertainty of 15%. The model of the F-center resonance as an inhomogeneous distribution of individual homogeneous packets with halfwidth $1/T_2$ and a common spin-lattice relaxation rate $1/T_1$ is theoretically analyzed, and results are summarized. Significant contributions to the absorption intensity from "forbidden" transition processes were observed and are discussed. Theoretical treatment of a spin system model is presented in which the mechanism

for the decay of transverse magnetization is described in terms of fluctuations in the local magnetic field (rather than being parameterized in the packet width $1/T_2$) yields predictions, which are consistent with the experimental results. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20676 XI. COLLOQUIUM SPECTROSCOPICUM INTERNATIONALE. (11th International Conference on Spectroscopy). Belgrade, Unija Hemijskih Drustava SRF Jugoslavije, 1963. 192p.

Abstracts of 186 papers on the applications, techniques, and equipment for spectroscopy are included. Solar spectra, chemical analysis, optical transition probabilities, Zeeman effect, Stark effect, hyperfine structure, Mössbauer effect, plasma diagnostics, isotope determination, spin-lattice relaxation, ESR, NMR, and x-ray spectroscopy are discussed. (C.E.S.)

20677 LINEARIZED MAGNETOGASDYNAMICS BASED ON TWO FLUID THEORY. S. I. Pai and S. K. Oh (Univ. of Maryland, College Park). 15p. (CONF-481-10)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The linearized equation of magnetogasdynamics for a uniform flow under uniform externally applied magnetic field of arbitrary orientation was derived from two fluid theory. It is a ninth order partial differential equation. This equation may be simplified by neglecting small terms under ordinary conditions. The simplified equations depend greatly on the fact whether there is a transverse applied magnetic field or not. With transverse applied field, the resultant simplified equation is of the same form as that of single fluid theory except that the magnetic Reynolds number in the two fluid theory is much smaller than that of single fluid theory. Without transverse field, the resultant simplified equation differs greatly from that of single fluid theory. (auth)

20678 CAVITATION IN LIQUID HELIUM. R. D. Finch, R. Kagiwada, M. Barmatz, and I. Rudnick (Univ. of California, Los Angeles). 15p. (CONF-416-2)

From American Physical Society Division of Fluid Dynamics, Cambridge, Mass., Nov. 1963.

Ultrasonic cavitation was induced in liquid helium over the temperature range 1.2 to 2.3°K, using a pair of identical transducers. The transducers were calibrated using a reciprocity technique and the cavitation threshold was determined at 90 kc/s. It was found that this threshold has a sharp peak at the λ point, but is, at all temperatures quite low, with an approximate range of 0.001 to 0.01 atm. The significance of the results is discussed. (auth)

Accelerators

20679 (CERN-64-14) MATCHING OF THE WAVEGUIDE COUPLER FOR THE RF SEPARATOR DEFLECTING STRUCTURE. P. Bramham and M. J. G. Lee (European Organization for Nuclear Research, Geneva). Feb. 21, 1964. 18p.

Radiofrequency energy was introduced into the disc-loaded deflecting structure by means of a coupler consisting of a waveguide mode transformer. In the absence of a well-matched terminating impedance for the disc-loaded waveguide, an approximately matched absorber was moved along inside it. This made it possible to plot the input admittance of the coupler corresponding to matched output conditions. Definitive couplers were matched by machining certain dimensions in stages and observing changes in the Smith chart plot. (auth)

20680 (NIRL/R/49) THE MULTIPLATE ELECTROSTATIC PARTICLE SEPARATOR. P. A. Chatterton (Gt. Brit. National Inst. for Research in Nuclear Science. Rutherford High Energy Lab., Chilton, Berks, England). Dec. 1963. 39p.

Experimental and theoretical limitations of an isolated multiplate electrostatic separator are considered. The discussion is restricted to decaying particles and in particular to the problem of (K,π) separation. Four possible modes of operation are considered and the respective limits on wanted particle transmission indicated. The transmission of each mode is calculated for the case of "just separated" phase areas. The mode that has the largest theoretical transmission transmits double that of a normal single gap separator at 500 Mev/c. The scattering from this design is liable to be severe so that poor rejection ratios are possible. A more practical design is shown to be the "earthed plane" separator. The calculations indicate that this design would have a 60% increase in transmission over that of a normal separator at 500 Mev/c. (auth)

20681 (TID-20457) QUADRUPOLE FOCUSING IN PROTON LINEAR ACCELERATORS FOR ENERGIES ABOVE 200 Mev. Yale Study on High Intensity Proton Accelerators. S. Ohnuma (Yale Univ., New Haven). Mar. 14, 1964. Contract [AT(30-1)-1349]. 34p. (Y-10)

The focusing requirements in the high-energy section of the 750-Mev proton accelerator were investigated. Stability diagrams were calculated for both quadrupole doublets and triplets. The effects of various magnet errors (tolerance requirements) were also estimated. It was concluded that quadrupole doublets are suitable for this application. (D.C.W.)

20682 (TID-20563) BEAM DESIGN. Internal Report No. 104. Ramon Pinon (Brown Univ., Providence). June 1963. Contract AT(30-1)-2262. 18p.

The program BEAM DESIGN, in Autocoder 74 for the IBM 7070, traces charged particles through free spaces and three types of magnetic fields. Input, output, and operation of the program are discussed; and the flow diagram and transformation equations are included. (D.C.W.)

20683 THE POWER BALANCE EQUATION IN A LINEAR ELECTRON ACCELERATOR. G. I. Zhileiko. At. Energ. (USSR), 16: 138-9(Feb. 1964). (In Russian)

The power of very-high-frequency oscillations in the accelerating waveguide is spent in the acceleration of particles, losses on the metal wall, and emissions connected with moving electron bunches. An equation was previously derived defining the power balance (Nauchnye Doklady Vyschei Shkoly; Radiotekhnika i Elektronika No. 2, 63: (1958)); this concept was developed further. The radiation losses were determined by solving the electrodynamic problem of the excitation of the waveguide by the convection current. At high energy levels, the problem may be solved without considering the effect of the radiation field on the electron beam. It was assumed that the emitted wave is of the same type and has the same frequency. The derived equation makes it possible to calculate the radiation losses R_{radn} of the electron beam system: $(R_{radn})_{max} = 250$ ohm/m and $(R_{radn})_{min} = 6.25$ ohm/m. It was concluded that under the assumption made, the effect of radiation on the power balance is negligible. (TTT)

20684 OPERATION OF THE ARKAD'EV-MARX CIRCUIT WITH HIGH DUTY FACTOR. G. A. Vorob'ev. At. Energ. (USSR), 16: 139-41(Feb. 1964). (In Russian)

In order to obtain accelerated charged-particle beams,

high-voltage pulses operated with a certain duty factor are required; this duty factor is determined by the number of pulses per second. Pulse amplitudes of the order of tens and hundreds of kilovolts may be created by the Arkad'ev-Marx pulse generator; the discharge elements of the generator must have a high impedance, reducing the discharge current to a negligible value. However, when the generator operates at a high duty factor, the desired impedance value cannot be reached and the discharge current becomes relatively large. This situation was examined for cases involving charging through active resistances or through the inductance. The results indicated that charging through the inductance is to be preferred. It was also found that charging by a pulsed-voltage source requires more time than by a constant-tension source. The time required may be further reduced by increasing the voltage. (TTT)

20685 ACCELERATING CYCLE IN A CIRCULAR PHASOTRON. E. P. Ovchinnikov and S. S. Semenov (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 141-6(1964). (In Russian)

A theoretical investigation of the accelerating cycle of a circular phasotron with a variable magnetic field is presented. (C.E.S.)

20686 ACHROMATIC QUADRUPOLE LENSES. S. Ya. Yavor, A. D. Dymnikov, and L. P. Ovsyannikova (Ioffe Inst. of Physics and Tech., Leningrad). Nucl. Instr. Methods, 26: 13-17(Feb. 1964).

An achromatic quadrupole lens is proposed and investigated, which is formed by electrostatic and magnetic fields imposed on each other. The compound lens thus obtained possesses first-order focussing properties of an ordinary quadrupole lens; however, depending upon the actual electrostatic and magnetic field strengths, it may both be achromatic and exhibit negative chromatic aberration. (auth)

20687 ON THE IRRADIATION OF AN INTERIOR TARGET IN A CIRCULAR ACCELERATOR. J. Andrade E Silva and G. Lochak (Faculte des Sciences, Orsay, France and Institut Henri Poincare, Paris). Nucl. Instr. Methods, 26: 22-8(Feb. 1964). (In French)

A theoretical analysis of the energy distribution of particles captured by a target inside a circular accelerator shows that the target behaves itself as an energy analyzer. Furthermore it is shown that the energy of particles striking the target is the better known and of a lower mean energy as it is measured farther away from the internal edge of the target. Therefore, this property allows to reduce strongly the uncertainty of energy on a part of the target, although at the price of a loss of radiation intensity. (auth)

20688 THE DESIGN OF A SCATTERING CHAMBER FOR SOLID STATE DETECTORS. A. Lieber (Princeton Univ., N. J.). Nucl. Instr. Methods, 26: 51-4(Feb. 1964). (PUC-1963-106)

A 20-inch-diameter aluminum scattering chamber has been constructed for use with the Princeton F.M. cyclotron. The chamber is portable and has been designed expressly for use with solid state detectors. Some of the design criteria and novel features of the chamber are discussed. (auth)

20689 THE ELECTRON INJECTION PROCESS IN THE BETATRON. G. Baciu (Inst. of Atomic Physics, Bucharest). Nucl. Instr. Methods, 26: 173-8(Feb. 1964).

The dependence of the injection process of the electrons in the betatron on the potential function that characterizes the magnetic field forces is described. The process connected with the existence of a variable circulating current in the accelerating chamber, and with the spatial charge due to the injection of electrons with different initial energy, is analyzed and used to explain the capture of electrons in the accelerating process. The electron-gun structure is avoided. The experimental method used for the study of these processes is indicated. (auth)

20690 SOURCE OF HIGH-INTENSITY PROTONS. R. A. Demirkhanov, Yu. V. Kursanov, and V. M. Blagoveshchenskii (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 30-3(Jan.-Feb. 1964). (In Russian)

A proton source with an emission current of 1.5 amp is described. Results of an investigation of the emission properties of the source in the impulse region are presented. (tr-auth)

20691 ION SOURCE FOR 1-Mev PROTON ACCELERATOR. A. A. Glazov, M. Kuzmyak, D. L. Nobikov, and L. M. Onishchenko (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 1, 34-7 (Jan.-Feb. 1964). (In Russian)

A pulsed ion source with a Penning discharge that uses a cold aluminum cathode is described. The characteristics of the power supply system for the ion source are described. An analysis of the beam focusing system is given, and results of an investigation of the dependence of the ion current on the various parameters of the ion source are presented. (tr-auth)

20692 ACCELERATION OF NEGATIVE IONS IN THE IAE CYCLOTRON. N. I. Venikov (Inst. of Atomic Energy, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 38-9(Jan.-Feb. 1964). (In Russian)

A current of 0.7 μamp of H^- ions was obtained in the external beams of the cyclotron. An internal beam of D^- ions was also obtained. The dependence of the accelerated current of negative ions on the vacuum chamber pressure and the gas flow rate in the ion source was investigated. (tr-auth)

20693 NUCLEAR PARTICLE ACCELERATORS. J. B. Adams (United Kingdom Atomic Energy Authority, Culham, Berks, Eng.). Proc. Roy Soc. (London), Ser. A, 278: 303-22(Apr. 7, 1964).

The development of static and alternating-gradient magnetic particle accelerators is traced. The physical principles underlying the construction of particle accelerators, and, in particular, the CERN proton synchrotron facility are discussed. (R.E.U.)

20694 NIMROD. T. G. Pickavance (Rutherford High Energy Lab., Harwell, Berks, Eng.). Proc. Roy Soc. (London), Ser. A, 278: 424-30(Apr. 7, 1964).

The status of the development of Nimrod proton synchrotron and its associated apparatus are discussed. The planned research program is reviewed. (R.E.U.)

20695 THE ELECTRON ACCELERATOR DESY. W. Jentschke (Deutsches Elektronen-Synchrotron Desy, Hamburg). Proc. Roy. Soc. (London), Ser. A, 278: 430-9 (Apr. 7, 1964).

The design and present status of the electron accelerator at Hamburg is discussed. Desy is a strong focusing electron synchrotron with E_{max} = 6 Bev. (R.E.U.)

20696 FEATURES OF THE NEXT GENERATION OF PROTON ACCELERATORS. K. Johnsen (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 278: 439-51(Apr. 7, 1964).

Limitations on scaling, new features, utilization, and

expected performance of high-energy proton synchrotrons are discussed. Storage ring principles, applications, and expected performance, and the advantages and disadvantages of colliding beams are discussed. (R.E.U.)

20697 FUTURE DEVELOPMENT IN WESTERN EUROPE. E. Amaldi (Università, Rome). Proc. Roy. Soc. (London), Ser. A, 278: 451-62(Apr. 7, 1964).

The development of electron and proton accelerators for energies above 200 Mev is considered. Some facilities in planning and construction are discussed. Storage ring development in Europe and the U.S.A. is reviewed. (R.E.U.)

20698 DECAY RATES OF H^- IONS IN THE ISOCHRONOUS CYCLOTRON ON THE BASIS OF LORENTZ FORCE. O. Boettger and H. Franke (AEG-Forschungsinstitut, Frankfurt am Main). Z. Naturforsch., 19a: 155(Jan. 1964). (In German)

The decay of negative H ions into electrons and atoms for energies greater than 10 Mev resulted in increasing masses by the separation on the basis of Lorentz force. The particle decay was calculated with regard to conditions in the 60° Thomas cyclotron. A curve of the dependence of H^- decay on energy was obtained. (M.C.G.)

20699 AN ACCELERATOR FOR HEAVY IONS. G. Hortig (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 176: 115-19(1963). (In German)

A heavy-ion accelerator on the basis of the multiple-stage operation of a small tandem-generator is proposed. The ions would be accelerated in the first half of the tandem in a charge state equilibrated in a foil stripper and then slowed down in the second half of the tandem in a charge state equilibrated in a gas atmosphere where the average charge is much lower than in a solid. One passage through the tandem would result in a gain of energy of $(Z_{solid} - Z_{gas}) \cdot eU$ Mev. The gain expected for the acceleration of iodine ions is of the order of 4 Mev for potentials at the high voltage electrode of about 1 Mv. The application of many of these systems in line or the application of a magnet system bending the ions many times through the same electric field and stripper allows acceleration of very heavy ions up to energies of about 1000 Mev. The transmission of this accelerator as a function of scattering, solid angle, and final particle energy is estimated. (auth)

20700 INVESTIGATIONS OF EXTERNAL ACTION ON ACCELERATED PARTICLE PHASE OSCILLATIONS. V. A. Bertulis. Zh. Tekhn. Fiz., 34: 218-25(Feb. 1964). (In Russian)

The influence of external interference with a spectrum near the synchrotron oscillation frequency and the influence of low-frequency incidental interference on accelerated particle dynamics were investigated. A method for determining induced oscillation stability is discussed. (tr-auth)

20701 INVESTIGATION OF ACCELERATED PARTIAL PHASE OSCILLATIONS BY MEANS OF HARMONIC LINEARIZATION. V. A. Bertulis (Tomsk Polytechnic Inst., USSR). Zh. Tekhn. Fiz., 34: 226-35(Feb. 1964). (In Russian)

Harmonic linearization is carried out on asymmetric nonlinear differential equations for particle phase oscillations. The stability and oscillations are analyzed as functions of amplitude and any arbitrary accelerator parameter without integrating differential equations. (tr-auth)

20702 LONGITUDINAL STABILITY OF CHARGED BEAM IN QUASISTATIONARY PROCESS IN CYCLIC CYCLOTRONS. V. K. Grishin (Moscow State Univ.). Zh. Tekhn. Fiz., 34: 307-10(Feb. 1964). (In Russian)

The azimuthal stability of a charged particle beam in dynamic equilibrium was analyzed for the case in which the lost particles (due to interactions with the injector or scattering in the residual gas) are compensated by the source. Such equilibrium takes place during cycled injection or during the last stages of particle accumulation. Variations in particle energy are analyzed independent of betatron oscillations. (R.V.J.)

20703 ON THE THEORY OF A CHANNEL CONSISTING OF MAGNETIC QUADRUPOLE LENSES FOR THE PRODUCTION OF PURE μ-MESON BEAMS AT VARIOUS ENERGIES. N. K. Abrosimov, D. M. Kaminker, I. A. Petrov, and S. G. Sherman (Leningrad Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 313-20(Feb. 1964). (In Russian)

Conditions conducive to the formation of a μ-meson beam in a channel consisting of magnetic quadrupole lenses distributed in succession were analyzed. The results hold for any arbitrary lens length. The stability of charged particle motion in a channel was investigated, and the maximum stability region was determined. Formulas for the optimum channel parameters l, d, k, A, and L were developed using a given pion pulse distribution at the channel inlet, and an expression was found for determining the channel efficiency. (tr-auth)

20704 VERTICAL FOCUSING OF ELECTRON BEAM WITH CYLINDRICAL MAGNETIC LENSES IN AXIALLY SYMMETRIC RADIALLY GROWING MAGNETIC FIELD. V. M. Kel'man, S. I. Levchenko, I. D. Luzyanin, and B. P. Peregud (Leningrad Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 321-5(Feb. 1964). (In Russian)

The focusing properties of the system were determined by measuring with a probe the electron current density in the chamber. The system was developed for effective vertical electron beam focusing in a radially growing axially symmetric leading field. The currents and first order trajectories were determined. Electron-optical properties indicate that the system can be efficiently utilized in a cyclotron to increase beam energy. The system may also be useful in developing various accelerators with continuous injection and radially growing leading fields. (R.V.J.)

20705 EFFECTIVE OPTIMUM FREQUENCY SHIFT IN AN INJECTOR ACCELERATOR. V. A. Vishnyakov and A. I. Zykov (Khar'kov Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 379-81(Feb. 1964). (In Russian)

An 83-cm accelerator with a constant phase wave velocity close to $\underline{c}$, with 83-kev initial electron energy and 6 Mev yield energy was used to show that by inserting a metallic piece into the central part of the transition it is possible to shift the effective acceleration region toward lower frequencies (or large phase wave velocities). Measurements were made of the dependence of the maximum electron capture frequency on the position of the insertion at various accelerating field intensities. An analysis of the dependence clarified the mechanism of the frequency shift in the region of effective capture, and quantitative ratios for the processes were formulated. The phase velocity variations in the basic high-frequency harmonics in congruent transition with corresponding frequency variations in the maximum capture can be utilized for securing optimum beam parameters and for correcting frequency characteristics. (R.V.J.)

20706 PROPOSED METHOD FOR OBTAINING BEAMS OF HOMOGENEOUS ENERGY FROM LOW-ENERGY ACCELERATORS. H. Maier-Leibnitz. 10p. (CONF-481-13)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The problem of improving the quality of particle beams after accelerator exit is considered. It is shown that the energy homogeneity of a beam can be restored after bunching by means of a long flight path and a-c acceleration. (C.E.S.)

20707 MICROMETEOROID SIMULATION USING NUCLEAR ACCELERATOR TECHNIQUES. J. F. Friichtenicht (Space Technology Labs., Canoga Park, Calif.). 23p. (CONF-354-9)

From Accelerator Conference, Boston, Nov. 1963.

A two-million volt Van de Graaff accelerator was modified so as to accelerate microparticles (dimensions the order of microns) to high velocities for micrometeoroid simulation. The modification is described, and the program of research on the physics of high speed impact, which was undertaken using the facility, is discussed. (auth)

20708 ACCELERATOR DESIGN CONCEPTS. [PART] I. A. John Gale (High Voltage Engineering Corp., Burlington, Mass.). 32p. (CONF-354-8)

From Accelerator Conference, Boston, Nov. 1963.

The problems of designing an adequate electrostatic accelerator are discussed. The problem of optimizing or maximizing the performance parameters of energy, current, energy stability, and ion species and charge state is considered. (C.E.S.)

20709 APPARATUS FOR REDUCING ENERGY VARIATIONS OF A VAN DE GRAAFF ION BEAM. Thomas R. Jeter and John D. Baldeschwieler (to U. S. Army). U. S. Patent 3,131,300. Apr. 28, 1964. Filed Nov. 16, 1962.

A method and means are described for reducing the energy fluctuations in an electron or ion beam from a Van de Graaff accelerator, so that the beam can be used to bombard a target in studies of resonances and gamma emissions. In the method, signals from both a slit system ahead of the analyzing magnet and the accelerator terminal are amplified and applied respectively to the terminal and the target to reduce the beam energy fluctuations. (D.L.C.)

Astrophysics and Cosmology

20710 (AFCRL-62-497) PROCEEDINGS OF THE SYMPOSIUM ON THE ASTRONOMY AND PHYSICS OF METEORS, CAMBRIDGE, MASSACHUSETTS, AUGUST 28–SEPTEMBER 1, 1961. Geophysical Research Papers No. 75. (Air Force Cambridge Research Labs. Geophysics Research Directorate, Bedford, Mass.). May 1962. 314p. (AD-417200)

Papers (43) on the theory, mass, spectra, observation, distribution, trails, erosion, luminosity, trajectories, and evolution of meteors and on studies of micrometeorites and dust are presented. Abstracts for six other papers are included. (D.C.W.)

20711 SURFACE X-RAY EMISSION FROM NEUTRON STARS. Hong-yee Chiu and E. E. Salpeter (Goddard Inst. for Space Studies, New York). Phys. Rev. Letters, 12: 413-15(Apr. 13, 1964).

Analytic estimates of the surface properties as a function of age of neutron stars are presented. The results for the total thermal energy, neutrino rate loss, photon luminosity, surface temperature, cooling time, and optimum wavelength are tabulated for several neutron core temperatures. (L.B.S.)

20712 EVOLUTION OF THE SOLAR SYSTEM AND THE EXPANSION OF THE UNIVERSE. R. H. Dicke and P. J. E. Peebles (Princeton Univ., N. J.). Phys. Rev. Letters, 12: 435-7(Apr. 13, 1964).

An investigation to find an effect of the time dependence of the cosmological background metric on the equations of motion of a dynamical system was made to show some connection between the evolution of the solar system and the expanding universe. A model universe containing matter in the form of a uniform continuous distribution of radiation or dust and a localized dynamical system consisting of cluster of galaxies were considered. (L.B.S.)

20713 LIMITS ON SOLAR NEUTRINO FLUX AND ELASTIC SCATTERING. F. Reines and W. R. Kropp (Case Inst. of Tech., Cleveland). Phys. Rev. Letters, 12: 457-9 (Apr. 20, 1964).

An experiment to obtain an upper limit on solar neutrino flux was performed. Problems involved in measuring the flux exactly are discussed. (M.J.T.)

20714 COMPARISON OF OBSERVED AND THEORETICALLY CALCULATED INTENSITIES IN THE CONTINUOUS SPECTRA OF MAIN-SEQUENCE B STARS. Bengt Stroemgren (Institute for Advanced Study, Princeton, N. J.). Rev. Mod. Phys., 36: 532-45(Apr. 1964).

Formulas are derived for computer calculation of model atmospheres in the range B1 to B8. Calculations were done for a presumed B star composition and a pure hydrogen composition. Results given here are (1) a B5V star model atmosphere, (2) some spectral intensities for the range B2–B8, and (3) some intensity ratios as functions of effective temperature and gravity. Comparison is made with other model atmosphere calculations and with observed intensities at 1314, 2120, and 3400 to 8000 Å. (M.J.T.)

20715 MASSIVE STARS, RELATIVISTIC POLYTROPES, AND GRAVITATIONAL RADIATION. William A. Fowler (California Inst. of Tech., Pasadena). Rev. Mod. Phys., 36: 545-55(Apr. 1964).

The requirements of hydrostatic equilibrium on the binding energy of a massive star, approximated as a relativistic polytrope, are discussed. A possible mechanism of gravitational-energy transfer from the collapsing core to the external surroundings is considered. (M.J.T.)

20716 THE CALCULATION OF STELLAR PULSATION. Robert F. Christy (California Inst. of Tech., Pasadena). Rev. Mod. Phys., 36: 555-71(Apr. 1964).

Methods developed to calculate the pulsation behavior of Stellar envelopes in RR Lyrae and Cepheid type pulsating stars are reported. The observed pulsations are assumed to arise spontaneously because of the equation-of-state and the opacity of the envelopes. (M.J.T.)

20717 THE SOLAR WIND. E. N. Parker. Sci. Am., 210: No. 4, 66-76(Apr. 1964).

Evidence for the sun's emission of a constant charged particle stream is reviewed. Auroral displays, magnetic storms, cosmic-radiation decrease during sunspot activity and Alfvén's theory, and the direction of comets' tails are discussed. Solar wind properties are considered. The extent of the sun's corona, the fact that the corona and solar wind are the same phenomenon, the coronal expansion, the process of coronal heating, and the shape and intensity of the solar wind's magnetic field are discussed. Confirmation of the calculated properties of the solar wind by spacecraft data is described. Calculations and experiments on the extent of the solar wind are summarized. (M.J.T.)

20718 THE EXPLODING GALAXY M82: EVIDENCE FOR THE EXISTENCE OF A LARGE-SCALE MAGNETIC FIELD. Allan R. Sandage and William C. Miller (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). Science, 144: 405-9(Apr. 24, 1964).

Photographs of galaxy M82 obtained in blue light show the existence of a previously unknown system of large-scale filaments extending 4000 parsec (1.2×10^{22} cm) above and below the fundamental plane of the galaxy along the minor axis. These filaments emit continuous radiation that is highly polarized, with the electric vector predominantly perpendicular to the filamentary structure. A plausible interpretation is that the radiation is optical synchrotron emission caused by relativistic electrons spiraling in a large-scale magnetic field. To produce radiation in visual wavelengths, the electron energies must be in the range 10^3 to 10^4 Bev if the magnetic field is between 10^{-5} and 10^{-4} gauss. (auth)

20719 THE FIB THEORY AND ITS INFLUENCE ON ASTRONOMICAL OBSERVATION METHODS. Jeno M. Barnothy and Madeleine Forro Barnothy (Univ. of Illinois, Chicago). Z. Physik, 176: 435-50(1963).

During the past fifty years some phenomena such as cosmic radiation, redshift, radio-galaxies, and CPT invariance were discovered, for which a fully satisfactory explanation is lacking. The fib theory is an attempt of their quantitative interpretation. The fib theory is described and its consequences on astronomical observations made with photographic plates or photocells (photomultipliers, image intensifiers, etc.) are discussed. (auth)

20720 COSMIC DUST. A. Dauvillier. Translated from La Poussiere Cosmique by Alan Crozy. New York, Philosophical Library, 1964. 172p.

The matter contained in interplanetary, interstellar, and intergalactic space is discussed. Asteroids, comets, meteors, and meteorites are also considered. (C.E.S.)

20721 THE SURFACE OF THE SUN. M. Hack. p.1-13 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The photosphere and the magnetic lines of force in the sub-photosphere turbulent zone are described. The chromosphere and corona are defined. Theories of support and heating of the solar atmosphere are explained. Various solar phenomena—sun spots, prominences and flares, and radio emissions—are classified. (M.J.T.)

20722 SOLAR CORPUSCULAR RADIATION AND THE NATURE OF THE EARTH'S IMMEDIATE INTERPLANETARY ENVIRONMENT. E. R. Harrison (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.65-84 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Evidence for the sun's emission of charged particle streams and for and against the solar wind theory is given. A solar wind is assumed, explaining the asymmetric teardrop shape of the distant non-rotating geomagnetic field as opposed to the symmetric nearby field, which turns with the earth. The origin of auroral streams and the nature of the gegenschein are discussed. (M.J.T.)

20723 THE PRODUCTION OF HIGH-ENERGY PARTICLES IN THE SUN AND IN THE SOLAR SYSTEM. E.-Å. Brunberg (Royal Inst. of Tech., Stockholm). p.85-98 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Solar flares and their relation to subsequent cosmic ray increases on earth are discussed. Various theories of propagation of flare particles to the earth are reviewed. Alfvén's theory of particle acceleration in the solar system by magnetic pumping is explained. (M.J.T.)

20724 THE INTERSTELLAR GAS AND THE GALACTIC HALO. H. C. van de Hulst (Leiden Observatory). p.220-6 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The kind of evidence that radioastronomy gives on the cosmic radiation is discussed. Some properties of the interstellar gas are listed. The dynamics of the galaxy and galactic halo are summarized. (M.J.T.)

20725 THE POLARIZATION OF STARLIGHT IN THE INTERSTELLAR MEDIUM. J. M. Greenberg (Rensselaer Polytechnic Inst., Troy, N. Y.). p.227-34 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Extinction and polarization of starlight are discussed. The physical and chemical nature and orientation of the scattering grains are considered. Scattering of light by the grains is explained. Predictions from different types of grains are compared. (M.J.T.)

20726 SOME RECENT INVESTIGATIONS ON PRIMORDIAL RARE GASES AND ^{129}Xe IN METEORITES. J. Zaehringer (Max-Planck-Institut für Kernphysik, Heidelberg). p.275-92 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The use of meteorite isotopic analysis for evidence on cosmic radiation and meteorite prehistory is mentioned. Production of isotopic variations in meteorites by natural and extinct radioactivity and spallation is considered. The rare gas content of achondrites and chrondrites is tabulated. The production of primordial xenon-129 from iodine-129 is discussed. (M.J.T.)

20727 COMBINED HYDROGEN- AND HELIUM-BURNING IN THE CORE OF A POPULATION II RED GIANT STAR. Georgeanne R. Caughlan and William A. Fowler. 30p. (CONF-417-27)

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

Combined hydrogen and helium burning was investigated to explain the anomalous abundances of carbon, barium, and rare earth elements in metal-poor stars. It is shown that under proper conditions of temperature and density it is possible to explain the five-fold enhancement of carbon and the twenty- to thirty-fold enhancement of barium and rare earths by helium burning in the core and combined hydrogen and helium burning in the edge of the core of a Population II red giant star of approximately one solar mass. (C.E.S.)

Atomic Physics

Refer also to abstract 20023.

20728 (AD-412421) THE PHOTOIONIZATION CROSS SECTION OF NEON FROM 80 A TO 600 A. Technical Report No. 10. D. L. Ederer (Cornell Univ., Ithaca, N. Y.). June 1963. Contract Nonr-401-(37). 99p.

The theory of the photoelectric effect is reviewed and previous investigations are listed in 58 references. The photoionization cross sections for Ne^+ were measured from 80 to 600 Å. The gas was confined in a cell instead of filling the spectrograph. A G-M counter was used in addition to photographic plates for detection of photoelectrons. (R.E.U.)

20729 (CONF-481-6) ATOMIC READJUSTMENT TO INNER SHELL VACANCIES IN NEON AND ARGON.

Thomas A. Carlson and Manfred O. Krause (Oak Ridge National Lab., Tenn.). 1963. Contract [W-7405-eng-26]. 12p.

From the American Physical Society Annual Meeting, New York, Jan. 1964.

Vacancies were produced in the K shell of Ne and the K and L shells of Ar by photoelectric ejection of electrons, and the charge distributions of the resultant ions were measured with a magnetic mass spectrometer. The results are compared with calculations and other data. The combined data show that extensive ionization accompanies the electronic readjustment and that Auger events play a major role in the reorganization. A satisfactory description of readjustment was obtained. (D.C.W.)

20730 (CONF-481-7) IONIZATION OF KRYPTON BY X-RAYS. M. O. Krause and T. A. Carlson (Oak Ridge National Lab., Tenn.). 1963. Contract [W-7405-eng-26]. 7p.

From the American Physical Society Annual Meeting, New York, Jan. 1964.

The charge distributions of Kr ions produced by photoelectric ejection of K- and L-shell electrons were measured with a magnetic mass spectrometer. The spectrum for K-shell ionization compares satisfactorily with that for electron capture. The spectrum for L-shell ionization was calculated surprisingly well by borrowing some transition rates from Tl. (D.C.W.)

20731 (RM-3803-AEC) THE STATISTICAL MECHANICS OF THE INTERDEPENDENT ELECTRONS IN THE SCREENING CONSTANT MODEL OF THE MANY-ELECTRON-ATOM. J. M. Green (RAND Corp., Santa Monica, Calif.). Apr. 1964. Contract AT(04-3)-414. 51p.

An operator treatment is described of the nonlinear (or many body) problem in statistical mechanics that arises when the screening-constant model is used to approximate the energy of an atomic configuration. Exact symbolic expressions are obtained for the electron occupation numbers and for the thermodynamically induced electron-electron correlations. Asymptotic forms are derived which may be used for the direct computation of these quantities. The forms exhibit explicitly the connection between the electron-electron interaction energy and the electron correlation and extend the classical occupation-number theory to second order in Z/kT. The significant asymptotic equations are numerically tested by comparing them with the results from an equation of state computation that is performed by evaluating in detail every term of the partition function of a simple (but nontrivial) four-level atomic system. (auth)

20732 (ORNL-3463) ELECTRON-SLOWING-DOWN SPECTRUM IN Cu OF BETA RAYS FROM Cu^{64}. W. J. McConnell, H. H. Hubbell, Jr., and R. D. Birkhoff (Oak Ridge National Lab., Tenn.). May 1964. Contract W-7405-eng-26. 65p.

Thesis submitted by W[illiam] J[ohn] McConnell to Vanderbilt Univ.

The electron flux spectrum resulting from the slowing down of electrons from ^{64}Cu uniformly distributed in Cu was measured from 0.1 ev to 37 kev for both a plane disk source and a black body cavity source. The cavity source consisted of a hollow Cu frustrum with walls infinitely thick for ^{64}Cu beta rays. A matching thick cover allowed only electrons from inside the cavity to enter the Keplertron, a spherical electrostatic beta spectrometer. The cavity data agreed well from 1 kev to 37 kev with a simplified calculation of the Spencer-Fano theory. Below 1 kev, the experimental flux exceeded the calculated flux by as much as 35% at 30 ev. A stopping power derived from proton data was used in the theory for electrons below 5.5 kev. A buildup of several orders of magnitude in the electron flux below 1 kev was observed. The disk data was lower than the cavity data at all energies above 1 kev, the former approaching the latter at higher energies. The beta spectrometer was calibrated for transmission and resolution from 1.5 ev to 3 kev using an isotropic electron gun and at 31.4 kev using the ^{152}Sm Auger line. (auth)

20733 (WIS-TCI-41) DIPOLE-QUADRUPOLE AND RETARDATION EFFECTS IN LOW-ENERGY ATOM-ATOM SCATTERING. Peter R. Fontana (Michigan. Univ., Ann Arbor) and Richard B. Bernstein (Wisconsin. Univ., Madison. Theoretical Chemistry Inst. and Wisconsin. Univ., Madison). Mar. 30, 1964. Contract [AT(11-1)-1328]. 16p.

Simple approximation formulas are derived for the dipole-quadrupole and retardation effects upon the total elastic scattering cross section for atomic collisions in the thermal energy range. For a long-range potential containing both the dipole-dipole and dipole-quadrupole terms, i.e., $V(r) = -(C^{(6)}/r^6)[1 + (\beta/r^2)]$, one finds $\Delta Q/Q_{MM} \cong (2\pi/3)(\beta/Q_{MM})$, where Q_{MM} is the Massey-Mohr cross section for an inverse-sixth power attraction. For a long-range potential including dipole-dipole and retardation effects, approximated by $V(r) = -(C^{(6)}/r^6)[a/(a + r)]$, one obtains $\Delta Q/Q_{MM} \cong -\pi^{-\frac{1}{2}} Q_{MM}^{\frac{1}{2}} a^{-1}$. Since these deviations are small and opposite in sign, it is concluded that the contributions of the dipole-quadrupole and retardation effects to the total cross sections are not sufficient to account for any significant discrepancy between theoretical and experimental Q values. Examples are given for He–Ar and Xe–Ar. (auth)

20734 (UCRL-Trans-1050(L)) MEASURING OF THE OUTPUT OF CHARACTERISTIC X RAYS, RELEASED BY PROTONS, FROM ALUMINUM (Al_K-RADIATION). Otto Peter. Translated for Univ. of California. Lawrence Radiation Lab., from Ann. Physik, 27: 299-311(1936). 20p.

The ratio of the total number of x-ray quanta emitted at the point of impact of the protons (uniform velocity) on the Al to the number of incident protons was determined to be $(6.22 \pm 0.31)\ 10^{-6}$ for protons at 132 kev. The results are compared with theoretical predictions for ionization in the K-shell by positive particles. (D.C.W.)

20735 INVESTIGATION OF THE QUANTUM THEORY OF COLLISIONS. [PART] III. V. D. Kamenetskii (All-Union Inst. of Textiles and Light Industries, USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 107-13(1964). (In Russian)

The previously developed analytical method for the exact resolution of quantum mechanical problems of collisions is considered. The correctness of the analytical expansion of the wave function in the vicinity of irregular singular points and the possibility of obtaining the scattering phase by direct examination of the power series expansion of the wave function in the asymptotic region are investigated. New dispersion relations are derived, and the relation between the function $D_l(k)$ and the S-matrix is established. The theory is applied to the solution of problems on elastic scattering of S-, P-, D-, F-, and G-electrons on atomic hydrogen and helium. The fast convergence of the wave function is investigated. The results of S- and P-wave calculations are compared with numerical integration. The exact wave functions for the scattering of D-, F-, and G-electrons on atomic hydrogen are obtained. (tr-auth)

20736 QUANTUM EFFECTS IN SMALL-ANGLE MOLECULAR-BEAM SCATTERING. E. A. Mason, J. T. Vanderslice, and C. J. G. Raw (Univ. of Maryland, College Park). J. Chem. Phys., 40: 2153-64(Apr. 15, 1964).

Quantum-mechanical calculations of the differential cross section for the small-angle elastic scattering of heavy particles were carried out to establish more definitely the region of validity of the classical approximation. Four results are discussed: the Massey–Mohr phase-shift formula corresponds to the Kennard small-angle scattering formula in the semiclassical limit; the Schiff approximation for the cross section is exactly the same as the semiclassical approximation at small angles, for any central potential; at very small angles the semiclassical limit for the differential cross section varies as $\exp(-c\theta^2)$, where c is a function of velocity for which explicit expressions are given; the first quantum deviation from the classical limit, which is proportional to $\hbar^2$, can be combined with the preceding result to give a reasonable representation of the differential cross section over the entire range of small angles for which quantum deviations are appreciable. Detailed calculations for some specific systems are made, and it is shown that Wu's misgivings over the classical interpretation of the experimental results of Amdur and co-workers are unjustified. (auth)

20737 HELIUM AFTERGLOW. I. ATOMIC SPECTRUM. C. B. Collins and W. W. Robertson (Univ. of Texas, Austin). J. Chem. Phys., 40: 2202-8(Apr. 15, 1964).

Spectroscopic investigation of a flowing helium afterglow revealed the presence of strong lines of neutral helium. An examination of the population distribution of the excited atomic states revealed the presence of a Saha equilibrium between the upper states and the free electrons indicating that the primary process of populating these states was the collisional-radiative recombination of He^+. A comparison of the axial variation and pressure dependence of the intensity of the emission with the He_2^+ and He^+ concentrations strengthened this conclusion. Observations were made at times from 50–250 μsec into the afterglow (flow velocity $\approx 6 \times 10^4$ cm/sec) in a system having a diffusion half life for He^+ of the order of 100 μsec, an ion density of 5×10^{12}/cc, and a maximum electron temperature corresponding to ≈0.15 ev. (auth)

20738 HELIUM AFTERGLOW. II. MOLECULAR SPECTRUM. C. B. Collins and W. W. Robertson (Univ. of Texas, Austin). J. Chem. Phys., 40: 2208-11(Apr. 15, 1964).

Spectroscopic investigation of a flowing helium afterglow revealed the presence of strong bands of He_2. An examination of the axial variation and pressure dependence of the intensity of the emission and He_2^+ concentration, as evidenced by titration, served to identify the dominant reaction populating the excited molecular states as being the collisional-radiative recombination of He_2^+. (auth)

20739 RADIAL CORRELATION IN HELIUM. George S. Handler (Tufts Univ., Medford, Mass.) and Hubert W. Joy. J. Chem. Phys., 40: 2408(Apr. 15, 1964).

Preliminary results on the energy limit reached for the ground state of helium with functions including radial coordinates only are reported. The results led to speculation on the use of angular (Θ_{ij}), rather than interelectronic (r_{ij}), coordinates in atomic systems. Data are tabulated. (P.C.H.)

20740 COLLISIONAL EXCITATION TRANSFER BETWEEN ATOMS IN THE RESONANT PROCESS. Masatake Mori, Tsutomu Watanabe, and Kanji Katsuura (Tokyo Univ.). J. Phys. Soc. Japan, 19: 380-6(Mar. 1964).

The excitation transfers through collision between hydrogen atoms and between other simple identical atoms are considered theoretically by an impact parameter method. A rotating atom approximation and a fixed atom approximation (concerned with the direction of electronic polarization) are applied to the problem. The cross section for the transfer of the excitation ($2p^2P$) of a hydrogen atom with thermal velocity (kinetic energy of 0.025 ev) to the other hydrogen atom in the ground state is estimated to be 3065 $Å^2$ with the rotating atom approximation and 680 $Å^2$ with the fixed atom approximation. In the case of helium atoms, the cross-section for the transfer of the excitation ($2p^1P$) is also estimated to be 606.7 $Å^2$ with thermal velocity. (auth)

20741 EXTRACTION OF HIGH CURRENT ION BEAMS WITH LOW DIVERGENCE. L. E. Collins and P. T. Stroud (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 26: 157-66(Feb. 1964).

The extraction of high-current ion beams from a duoplasmatron ion source, and the cause of the large beam divergence with a "Pierce" type extractor, are discussed. A modified extraction system composed of two cylindrical electrodes with a magnetic coil on the extractor electrode to adjust the plasma shape is described which gives 50 mA of hydrogen ions at 20 kev with a divergence of ±3 to 6°. Measurements of the current density, ion beam composition, and effect of the applied magnetic fields are given. The beam emittance has also been measured and the beam appears to originate from two apparent sources, a small area on axis and a larger diameter ring source. This probably arises from the shape of the plasma boundary and the geometry of the extractor electrodes. (auth)

20742 CHARGE-EXCHANGE PROCESSES BETWEEN RARE-GAS IONS AND SOME MOLECULES. A. Galli, A. Giardini-Guidoni, and G. G. Volpi (CNEN, Rome and Università, Rome). Nuovo Cimento (10), 31: 1145-64 (Mar. 16, 1964).

Charge exchange processes between Ar, Kr, and Xe ions and some molecules were investigated in the energy range 15 to 100 ev for singly charged primary ions, and 80 to 200 ev for doubly charged primary ions. Their cross sections were measured both for formation of secondary parent ions and for fragments. The results are found to be in satisfactory agreement with theoretical predictions. (auth)

20743 OUTLINE OF A PERTURBATION THEORY OF THE HYDROGEN MOLECULE. PART III. E. Corinaldesi (Univ. of Toronto). Nuovo Cimento (10), 31: 1258-64 (Mar. 16, 1964).

The correspondence between the eigenfunctions of the Modified Schroedinger Equation (M.S.E.) for the hydrogen molecule and the symmetrized eigenfunctions of the ordinary Schroedinger equation is discussed, together with the role played by the arbitrary parameter appearing in the M.S.E. hamiltonian. A nonempirical criterion is given for determining the best value of such a parameter. (auth)

20744 SEMIEMPIRICAL METHOD FOR DETERMINATION OF THE ELECTRON-PRODUCED ELECTROSTATIC POTENTIAL AT THE NUCLEUS OF AN ATOM. T. K. Rebane. Opt. Spectry. (USSR) (English Transl.), 16: 89-90 (Jan. 1964).

An expression for the electrostatic potential produced by electron shells of the atom and located at the center of the nucleus is derived from the Schroedinger equation. An exact analytic form for this expression can be obtained only for N (the number of electrons) = 1. Semiempirical interpolation formulas are quoted for $2 \leq N \leq 6$. Potential values

calculated using these formulas are given for ground states of some light atoms and ions with $N \leq 6$ and are compared with theoretical values. (M.J.T.)

20745 THE SPUTTERING OF METALS WITH NOBLE GAS IONS; AN EXPERIMENT TO DETERMINE THE FATE OF THE INJECTED GAS AND ITS INFLUENCE ON THE SPUTTERING PROCESS. R. S. Nelson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phil. Mag. (8), 9: 343-7(Feb. 1964). (AERE-M-1289)

Micrographs of thin copper foils irradiated at 20, 350, and 500°C with 10^{17} A^+ ions are shown and the results are discussed. It is concluded that the majority of the rare gas atoms precipitate into bubbles, leaving the surrounding metal free from dissolved impurities. Collision sequences travel directly to the surface and are not influenced by the injection gas. (L.B.S.)

20746 ELECTRONIC EXCITATION OF DIAMOND BY ENERGETIC CHARGED PARTICLES. P. J. Dean and J. C. Male (London Univ.). Phys. Chem. Solids, 25: 311-21 (Mar. 1964).

The mean energy, ϵ_α, absorbed from α particles whose energy was varied between 1 and 5.3 Mev in the creation of a free electron-hole pair was measured for a large number of specimens of natural diamond, using the conduction counting technique. The limiting minimum value found for ϵ_α(24.5 ± 1 ev) was compared with the previously reported value obtained using β-particle excitation (ϵ_β = 18.5 ± 1.5 ev). The observed difference between ϵ_α and ϵ_β is explained quantitatively in terms of the large ratio between the α and β-particle scintillation efficiencies ($S_\alpha/S_\beta \doteq 50:1$). The method of measurement of S_α and S_β is described. The mechanism of the electronic excitation process is discussed in terms of a plasma resonance of the valence electrons (plasma creation). The value of ϵ_β is interpreted in terms of the decay of the plasmons into the excitation of secondary electrons and the emission of optical phonons. Finally the origin of the large value of S_α/S_β is shown, from an analysis of the effect of an externally applied electric field upon the values of S_α and S_β, to be connected with the magnitude of the self-field produced in the excitation channel (track of the primary particle). The principal spectral component of the scintillation emission (blue band) was previously identified with the extrinsic recombination of excitons, and the effects produced by an electric field on the particle-induced luminescence are discussed in terms of this hypothesis. (auth)

20747 CLUSTER EXPANSION IN THE HEITLER-LONDON APPROACH TO MANY-ELECTRON PROBLEMS. Tadashi Arai (Argonne National Lab., Ill.). Phys. Rev., 134: A824-40(May 18, 1964).

The Heitler-London method based on nonorthogonal atomic orbitals is applied to arrays of an infinitely large number of atoms. The electronic energy is given by a quotient with strongly divergent numerator and denominator, which until now defied correct computation. The resemblance of this problem to the linked-cluster expansion in many-body problems led to the development of a new method to compute the Heitler-London energy. Here, the numerator and denominator are divided simultaneously by a common factor, which leads to a set of recurrence relations between the normalization matrices F. The matrices F are essential parts of the quotient to be calculated. When an overlap integral $\langle k|h \rangle$ is represented by a line starting from h and ending at k, the calculation of F using the recurrence relations is carried out systematically by drawing diagrams consisting of connected loops. Since the present aim in applying the Heitler-London method is to compute spin-wave spectra, the calculation is carried out in the complete space of spin waves and the energy expression is given by a Hermitian matrix. This process introduces additional matrices A. The computation of A is also carried out by the diagram technique, since A can be expanded into an asymptotic series using F. Finally the energy matrix is written as a sum over connected diagrams, in accordance with the speculation obtained from the linked-cluster expansion. An error introduced by truncating the series of diagrams is also calculated. The present method not only ensures that the energy density in the Heitler-London method is finite, but also provides an accurate and practical way to compute the Heitler-London energy. To calculate the ground-state energy the technique is simplified since the computation of A can be completely eliminated. (auth)

20748 THOMAS-FERMI THEORY OF THE ATOM AS A SOLUTION OF THE DENSITY-MATRIX HIERARCHY. Nandor L. Balazs (State Univ. of New York, Stony Brook). Phys. Rev., 134: A841-52(May 18, 1964).

It is shown that the Thomas-Fermi (TF) theory for a neutral atom is the zeroth-order solution of the full N-body problem if (a) the following assignments of smallness are made: $N^{-\frac{1}{3}} = \epsilon$, $e = e_0\epsilon^{\frac{1}{2}}$, $m = m_0/\epsilon^2$, $\epsilon \to 0$; (b) the singlet density matrix in the x representation, $\rho_1(x',x)$, is a fast oscillating function of the off-diagonal elements, of the type $\sin[(x' - x)/\epsilon]$; (c) the higher-order density matrices are determinants of the singlet density matrix as $\epsilon \to 0$. The higher-order approximations, however, cannot be obtained by a simple power-series expansion in ϵ, since the solutions contain ϵ in a nonanalytical fashion. The equations found by Kompaneets and Pavlovskii, and Baraff and Borowitz are obtained by taking into account the exclusion principle to zeroth order in ϵ, and solving the equations of motion for the singlet density matrix to the next-higher-(second-) order approximation. These contain the Dirac and Weizsäcker corrections. Finally, conjectures about possible improvements of the approximation scheme are offered. (auth)

20749 THEORY OF CORE-ELECTRON CONTRIBUTIONS TO HYPERFINE INTERACTIONS. G. D. Gaspari, Wei-Mei Shyu, and T. P. Das (Univ. of California, Riverside). Phys. Rev., 134: A852-62(May 18, 1964).

A convenient method is devised for the calculation of magnetic hyperfine constants in atoms, molecules, and metals taking into consideration the exchange interaction between the core electrons and the unpaired valence electrons. In this method, the core-electron wave functions are perturbed by the nuclear magnetic moment via the Fermi contact term, and the energy of the system is then calculated in the Hartree-Fock approximation using the perturbed core wave functions. The present method is closely related to the exchange perturbation method of Cohen, Goodings, and Heine. However, the former has the advantage of being more flexible in the sense that the same perturbed core-electron functions may be used for the ground and excited states of the atom and for metals without significant error. For lithium atom $1s^12s$ and $1s^12p$ states, values were obtained for the core contribution to the hyperfine constant a (in $aI \cdot S$) of 83.76 Mc/sec and −8.9 Mc/sec in good agreement with the earlier values of Cohen, Goodings, and Heine. This method was applied to a calculation of the core-polarization correction to the Knight shift in lithium metal using recent wave functions of Kohn and

Callaway. The core-polarization corrections produced by the s and p parts of the conduction-electron wave function are nearly equal but opposite in sign, while that produced by the d part is an order of magnitude smaller. The net correction is about −5.3% of the direct contribution to the Knight shift. (auth)

20750 INELASTIC SCATTERING OF ELECTRONS BY THE HYDROGEN MOLECULE ION. James M. Peek (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 134: A877-83(May 18, 1964).

The inelastic scattering of electrons by H_2^+ is investigated by means of the first Born approximation. The integral that must be evaluated to find the differential cross section for mixed internuclear separation is studied for an electronic excitation from the ground state to any discrete excited state, using the exact electronic wave functions. Values related to this integral are tabulated for the processes $1s\sigma_g - 2p\sigma_u$, $1s\sigma_g - 2p\pi_u$, $1s\sigma_g - 2s\sigma_g$ at the equilibrium internuclear distance; the first case is studied at two additional internuclear separations. The corresponding total cross sections are calculated for incident energies up to 400 ev. It is known that an observed cross section necessarily depends on the initial vibrational state of the molecular ion, assuming rotational and vibrational levels of the final electronic state can not be resolved. The effect of two different initial vibrational states ($\nu = 0,3$) is investigated for the $1s\sigma_g - 2p\sigma_u$ case, and it is observed that the vibrational state has a marked influence on the total cross section. (auth)

20751 ΔS = ±1 MAGNETIC MULTIPOLE RADIATIVE TRANSITIONS. Masataka Mizushima (Univ. of Colorado, Boulder). Phys. Rev., 134: A883-8(May 18, 1964).

The magnetic multipole transition probability is calculated in terms of the matrix elements of the magnetic multipole. The magnetic jm moment $Q_{jm}^{(mg)}$ is defined as $(e/\mu)[4\pi/(2j+1)]^{1/2} \Sigma(\nabla r_i^j Y_{jm})[(j+1)^{-1}l_i + s_i]$, where e and μ are electron charge and electron mass, r_i, l_i, and s_i are the coordinate, orbital angular momentum, and spin angular momentum of the ith electron, and Y_{jm} is the spherical harmonic. Magnetic quadrupole and octupole moments are explicitly given. It is shown that for the $^3\Sigma_u^+ \rightarrow {}^1\Sigma_g^+$ transition of the hydrogen molecule, the magnetic quadrupole transition is more important than the conventional spin-orbit electric dipole transition. The magnetic octupole transition has the same order of magnitude as the spin-orbit magnetic dipole transition. (auth)

20752 ABSOLUTE ELECTRON EXCITATION CROSS SECTIONS OF HELIUM. Robert M. St. John, Frank L. Miller, and Chun C. Lin (Univ. of Oklahoma, Norman). Phys. Rev., 134: A888-97(May 18, 1964).

The absolute apparent electron excitation functions of helium were measured for the 3^1S, 4^1S, 5^1S, 6^1S, 3^1P, 4^1P, 3^1D, 4^1D, 5^1D, 6^1D, 3^3S, 4^3S, 5^3S, 3^3P, 3^3D, 4^3D, 5^3D, and 6^3D states at pressures sufficiently low so that the effects of radiation imprisonment and collisional excitation transfer can be neglected. The data were corrected for polarization of the radiation and cascading from the upper excited states, and the true excitation functions obtained. The peak values and shape of these excitation functions are compared with results of other laboratories. Generally good agreement is found with previous works where the collisional excitation transfer was properly reduced and allowance made for the cascading effect. The experimental cross sections show satisfactory agreement with the theoretical values calculated by the Born approximation for the ^1S and ^1P states at high electron energies, but are about four times larger than the theoretical values for ^1D states. For the triplet series, the experimental cross sections exceed the calculated values by factors of ten to one hundred or more. It is concluded that the population of the triplet states is produced mainly by processes other than direct excitation. (auth)

20753 K-SHELL PHOTOELECTRIC CROSS SECTIONS FROM 200 kev TO 2 Mev. R. H. Pratt (Stanford Univ., Calif.), Richard D. Levee, Robert L. Pexton, and Walter Aron. Phys. Rev., 134: A898-915(May 18, 1964). (CONF-63-5)

A numerical program was developed for the calculation of atomic photoelectric differential and total cross sections, taking into account all polarization correlations. The program is designed to calculate relativistic Coulomb wave functions in a screened central potential; the outgoing continuum wave function is obtained in a partial-wave series. Results are presented here for K-shell differential and total cross sections in point Coulomb potentials (i.e., unscreened) ranging from charge Z = 13 to Z = 92, and covering the range of incident photon energies from 200 kev to 2 Mev. Enough data are presented to permit interpolation throughout these ranges. The total cross sections above 1 Mev are found to be significantly lower than previously accepted values. Further, the angular distributions from heavy elements deviate greatly from the commonly used Sauter distribution. These features are discussed and compared with existing experimental and theoretical work. (auth)

20754 POLARIZATION CORRELATIONS IN ATOMIC PHOTOEFFECT. R. H. Pratt (Stanford Univ., Calif.). Richard D. Levee, Robert L. Pexton, and Walter Aron. Phys. Rev., 134: A916-22(May 18, 1964). (CONF-63-6)

The seven possible polarization correlations between incident photon and ejected electron in K-shell photoeffect were obtained by numerical methods for the range of elements from Z = 13 to Z = 92 and the range of energies from 200 kev to 2 Mev. The photoeffect can serve as a polarizer of electrons, a transmitter of polarization from photons to electrons, or an analyzer of polarized radiation. In heavy elements at suitable angles of emission all these correlations can be large. Previous work on the correlations is discussed. (auth)

20755 LOW-FIELD DE HAAS-VAN ALPHEN EFFECT IN COPPER. A. S. Joseph (North American Aviation Science Center, Canoga Park, Calif.) and A. C. Thorsen. Phys. Rev., 134: A979-80(May 18, 1964).

The de Haas-van Alphen effect was observed in a copper single crystal by means of a null-deflection torsion balance technique. Detailed measurements were carried out, providing an accurate determination of the topology of the Fermi surface necks in copper. Effective mass values are found to be in excellent agreement with cyclotron resonance results. Unusual behavior observed in the angular dependence of the amplitude of the oscillatory torque is attributed to the spin-splitting factor in the theoretical expression for the magnetization. (auth)

20756 ENERGY TRANSFER PHENOMENA IN LIQUID HELIUM. Joshua Jortner, Lothar Meyer, Stuart A. Rice, and E. G. Wilson (Univ. of Chicago). Phys. Rev. Letters, 12: 415-16(Apr. 13, 1964).

A spectroscopic study of the light emitted from liquid helium bombarded by alpha particles from a 50-mC ^{210}Po source was made to investigate the temperature dependence of the emission. Observations, which support the energy transfer mechanism, are reported. The emission spectrum

of liquid helium containing $N_2 + O_2$ is shown. Rough estimates of the efficiency of the scintillation process show that the light output energy is ~0.1% the alpha energy. (L.B.S.)

20757 AUTOMATIC STABILIZATION OF A BEAM OF FAST ATOMIC PARTICLES. V. V. Afrosimov, I. F. Kalinkebich, and I. T. Serenkov (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 1, 143-6(Jan.-Feb. 1964). (In Russian)

A method is proposed for stabilizing the intensity and direction of a beam of fast ions or atoms in a device of the mass spectrometer type. The method is based on the direct control of the beam intensity in this device, which is intended for experiments with atomic beams. (tr-auth)

20758 THE ORDER OF ELECTRON SHELLS IN IONIZED ATOMS. S. A. Goudsmit and Paul I. Richards (Brookhaven National Lab., Upton, N. Y. and Technical Operations, Inc., Burlington, Mass.). Proc. Natl. Acad. Sci. U. S., 51: 664-71(Apr. 1964). (BNL-7786)

Approximate solutions for the statistical electron distribution in the Thomas-Fermi atom are extended to ionized atoms because of interest in spectra of highly ionized atoms. (R.E.U.)

20759 ANALYTIC SELF-CONSISTENT FIELD FUNCTIONS FOR THE CONFIGURATIONS $1s^2 2s 2p^k$. P. S. Kelly (Lockheed Missiles and Space Co., Palo Alto, Calif.). Proc. Phys. Soc. (London), 83: 533-5(Apr. 1964).

Analytic self-consistent field wave functions are presented for ten terms in Be, B, C, F, and Ne. (auth)

20760 ELECTRON IMPACT SPECTROSCOPY. II. VIBRONIC INTERACTIONS IN EXCITATION CROSS SECTIONS. F. H. Read (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 83: 619-27(Apr. 1964).

The effect of vibronic interactions on the differential cross sections for excitation of a molecular state, without change of spin multiplicity, by inelastic electron scattering at high incident energies is investigated. A rule is derived for obtaining from measured cross sections some information about the symmetry species of the excited state. The relation between the general shape of inelastic electron spectra measured at forward angles and the corresponding optical absorption spectra is also discussed. (auth)

20761 THE THRESHOLD LAW FOR IONIZING COLLISIONS. M. R. H. Rudge (Queen's Univ., Belfast) and M. J. Seaton. Proc. Phys. Soc. (London), 83: 680-2(Apr. 1964).

Let $I(k,k')\, d\hat{k}\, d\hat{k}'\, d(\frac{1}{2}k^2)$ be the differential cross section for ionization of a neutral atom by electron impact, k, k' being the velocities of the outgoing electrons and the total energy being $E = \frac{1}{2}(k^2 + k'^2)$. It is shown that, as $E \to 0$, $I(k,k')$ goes to a finite limit if $1/k + 1/k' - 1/|k - k'|$ is positive, and to zero otherwise. Near threshold the total ionization cross section is proportional to E. (auth)

20762 SIMULTANEOUS MEASUREMENTS OF HYPERFINE STRUCTURE, STARK EFFECT, AND ZEEMAN EFFECT OF $^{39}K^{19}F$ WITH A MOLECULAR-BEAM-RESONANCE SPECTROMETER. G. Graeff and Ö. Runolfsson (Universität, Bonn). Z. Physik, 176: 90-114(1963). (In German)

An electric molecular-beam-resonance spectrometer was used to measure simultaneously the Zeeman- and Stark-effect splitting of the hyperfine structure of $^{39}K^{19}F$. Electric four pole lenses served as focusing and refocusing fields of the spectrometer. A homogenous magnetic field (Zeeman field) was superimposed on the electric field (Stark field) in the transition region of the apparatus. The observed ($\Delta m_J = \pm 1$) transitions were induced electrically. Completely resolved spectra of KF in the J = 1 rotational state were measured. The electric dipolmoment μ_{el} of the molecule for v = 0, 1 and 2; the rotational magnetic dipolmoment μ_J for v = 0, 1; and the difference of the magnetic shielding $(\sigma_\perp - \sigma_\parallel)$ by the electrons of both nuclei as well as the difference of the molecular susceptibility $(\xi_\perp - \xi_\parallel)$ were determined. The numerical values are $\mu_{el} = 8{,}585$ (4) deb, $(\mu_{el})_{v=1}/(\mu_{el})_{v=0} = 1{,}0080$, $\mu_J/J = (-)\ 23,\ 52(10) \times 10^{-6}\ \mu_B$, $(\sigma_\perp - \sigma_\parallel)_F = (-)\ 2,\ 19(9) \times 10^{-4}$, $(\sigma_\perp - \sigma_\parallel)_K = (-)\ 12(9) \times 10^{-4}$, and $(\xi_\perp - \xi_\parallel) = 3(1) \times 10^{-30}$ erg/Gauβ^2. The quantities in brackets are twice the root-mean-square deviations in units of the last digit. From these data and the spin-rotational interaction constants a number of expressions were derived that characterize the electronic charge distribution in the molecule. (auth)

20763 ON THE THEORY OF THE SCATTERING OF $^7Li^+$ IONS ON RARE GASES. H. Schoenebeck (Technische Universität, Berlin). Z. Physik, 177: 111-25(1964). (In German)

The angular distribution of $^7Li^+$ ions scattered by rare gas atoms showed, at scattering angles in the order of $10^{-4} < \theta < 10^{-3}$ rad, characteristic maxima of intensity. These maxima cannot be explained by the electron scattering theory applying electrons equi-energetic to the $^7Li^+$ ions. Therefore the interaction potential between the scattered $^7Li^+$ ions and the rare gas atom was extended in such a way, that the mutual action of the charge distributions of both systems was taken into account. A simple form for this potential gives positions of the maxima that are in good agreement with the experimental values. (auth)

20764 SCATTERING OF 25-kev ELECTRONS ON GASES. II. SCATTERING ON NEON, ARGON, KRYPTON, AND XENON. J. Geiger (Technische Universität, Bonn). Z. Physik, 177: 138-45(1964). (In German)

The differential cross sections of neon, argon, krypton, and xenon for elastic scattering and for excitation of optical transitions were measured. For neon and argon the elastic angular distribution can be described by the cross section calculated according to Wentzel and Lenz. For krypton and xenon there were considerable deviations from the Wentzel-Lenz cross section. In these cases it was better to calculate the elastic differential cross section from Slater eigenfunctions, from Thomas-Fermi-Dirac, or from Hartree-Fock electron density distribution. The differential cross sections for the excitation of optical transitions, so far as measured, obeyed for $\vartheta < \vartheta_c$ the dipol approximation, i.e., for angles not too small the inverse square angular dependence was valid. ϑ_c was higher for the heavier rare gases. The oscillator strengths for some transitions were determined from the scattering measurements in satisfactory agreement with theoretical values. (auth)

20765 NUMERICAL CALCULATIONS OF RESONANCE BEHAVIOR OF THE SCATTERING CROSS SECTION FOR ATOMIC COLLISIONS. [PART] II. R. Dueren and H. Pauly (Universität, Bonn). Z. Physik, 177: 146-50(1964). (In German)

The undulatory behavior in the velocity dependence of the total elastic cross section Q(v) for atom-atom scattering can be calculated by the semiclassical approximation. In a previous paper numerical values of the classical deflection function, which are necessary to evaluate the amplitude of the extrema in Q(v), were reported for a Kihara-potential as a function of the reduced energy K and the potential parameter α. The correspondent reduced maximum phase shifts $\eta_0^*(K,\alpha)$, which determine the location of the extrema, are given. The results for the Kihara-potential are com-

pared with similar calculations for a Lennard-Jones-(n,6)-potential. (auth)

20766 ATOMIC LEVEL ENERGIES IN HAFNIUM. Stig Hagstroem (Uppsala Univ.). Z. Physik, 178: 82-100 (1964).

The photoelectron method for obtaining electron binding energies is described. The method was applied to the L_I, L_{II}, and L_{III} levels in hafnium. The Hf K α_1 and Hf K α_2 x-ray emission lines were measured with a crystal spectrometer. The electron binding energies of the K to O_{III} shells in hafnium were obtained from photoelectron and x-ray emission data. A type of Moseley diagram is described and is demonstrated for the K and L levels in the Z region 57 to 75. From these diagrams accurate binding energies for the element Pm (Z = 61) were obtained by interpolation. (auth)

20767 ELECTRON BINDING ENERGIES IN THORIUM. Carl Nordling and Stig Hagstroem (Uppsala Univ.). Z. Physik, 178: 418-32(1964).

Sixteen atomic level energies in the L, M, N, and O shells of thorium were measured by the electron spectroscopic method. The precision achieved in the measurements was better than one electron volt. The Fermi level was observed as an edge in the photoelectron spectrum. A complete set of electron binding energies, based on electron spectroscopic data, is given. (auth)

20768 IONIZATION ENCOUNTERS OF ELECTRONS WITH IONS AND ATOMS. Z. Z. Latypov, S. E. Kupriyanov, and N. N. Tunitskii (Inst. of Physics and Chemistry, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 833-9(Mar. 1964). (In Russian)

The single ionization cross sections for Hg^+, Xe^+, Kr^+, Ar^+, Ne^+, Hg^{2+}, Xe^{2+}, Kr^{2+}, and Ar^{2+} ions obtained by ionizing atoms with electrons are determined by the crossed ion and electron beam method. The dependences of the effective cross sections for secondary electron ionization of ions on the electron energy of the initial ions are determined. It is shown that ionization of neutral atoms by electron impact involves the excitation of singly, doubly, and triply charged ions. It is also shown that for an accelerating potential of 2800 v the mass spectrometer background is mainly due to various ionization processes involving metastable excited ions. (auth)

20769 RESONANCE CHARGE EXCHANGE IN SLOW COLLISIONS. B. M. Smirnov. Zh. Eksperim. i Teor. Fiz., 46: 1017-24(Mar. 1964). (In Russian)

The resonance charge exchange cross section is determined by the magnitude of the electron energy level splitting $\epsilon_u - \epsilon_g = f(R)$ (R is the distance between the nuclei) which is exponentially small at large values of R and hence can be determined only with an accuracy to a preexponential factor by perturbation theory methods. The method employed can be used to calculate the preexponential factor for $\epsilon_u - \epsilon_g$ in the case of an electron in the field of two Coulomb charge centers Z. It is shown that for an asymptotic form $\epsilon_u - \epsilon_g = AR^n \exp[-\sqrt{-2w}R]$, which is valid for a system consisting of an arbitrary atom and its ion (w is the electron energy), the relation between the collision rate and resonance charge exchange cross section can be satisfactorily described by the Firsov formula. The relation between the collision rate and resonance charge exchange cross section for a charge Z and a hydrogen-like atom in the ground and excited states is established. (auth)

20770 EXCITATION AND IONIZATION OF ATOMS IN A STRONG RADIATION FIELD. F. V. Bunkin and A. M. Prokhorov (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1090-7(Mar. 1964). (In Russian)

Some general results are obtained regarding the behavior of atomic systems in a strong radiation field. By the latter is understood a radiation field with such a density that the energy of interaction between it and the atomic electrons approaches that between the electrons and nucleus. It is shown, in particular, that if the interaction time between the atom and field is sufficiently large, atomic ionization will be more probable than its excitation in the bound state even though the field quantum $\hbar\omega$ may be much smaller than the ionization potential I. Some estimations of the photoionization potential for $\hbar\omega \ll I$ are presented. (auth)

20771 DETACHMENT OF ELECTRONS IN SLOW COLLISIONS BETWEEN NEGATIVE IONS AND ATOMS. Yu. N. Demkov (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 1126-35(Mar. 1964). (In Russian)

The nonstationary quantum problem in which the bound state of a quantum system at first approaches and then for a certain time merges with the continuous energy spectrum due to the slow variation of an external parameter is considered in the general form. Such conditions may occur during collisions between negative ions and atoms. The energy distribution of the emitted particles (electrons) is obtained and the probability that the system remain in the bound state (i.e., no electron is detached from the negative ion) is determined. (auth)

20772 LOW ENERGY CESIUM ION-ATOM COLLISION CROSS SECTIONS. R. H. Bullis (United Aircraft Corp., East Hartford, Conn.). p.1-9 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The cesium ion-atom total collision cross section was measured over the energy range of 0.1 to 10 ev. A modified Ramsauer collision chamber in which contact potential differences were eliminated was employed in the measurements. For energies less than 1 ev, small stray electric fields of the order of millivolts per centimeter drastically affect ion trajectories in magnetic fields giving rise to spurious experimental results. Therefore, the basic concept employed in these measurements was to produce a completely field free region in which the energy of the ion beam can be uniquely determined and in which the collisional event can take place. Cesium ions were produced by contact ionization of cesium atoms on a hot tungsten surface. Ion beam currents focused through the collision chamber for energies of 1 to 10 ev followed a $V^{\frac{1}{2}}$ dependence. For energies below 0.8 ev the ion current attenuated faster than would be predicted from the $V^{\frac{1}{2}}$ or Child's law dependence. Ion beam current at a beam energy of 0.1 ev was approximately 6×10^{-18} amperes. The cesium ion-atom total collision cross section measured at an ion energy of 0.12 ev was 24,185 P_c (number of collisions per centimeter of path at one millimeter gas pressure). At an ion energy of 9.7 ev the measured cross section was 5,415 P_c. These results are compared to results of others and are related to typical operating conditions in a cesium vapor thermionic converter. (auth)

20773 COLLISION CROSS SECTION OF LOW ENERGY ELECTRONS WITH CESIUM ATOMS. Richard K. Flavin and Russell G. Meyerand, Jr. (United Aircraft Corp., East Hartford, Conn.). p.10-16 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The electron cyclotron resonance absorption technique was used to measure the collision frequency for momentum transfer between electrons and cesium atoms over an electron energy range of 650–975°K. The measurements were made under the conditions of thermal ionization equilibrium (Saha equilibrium) using a microwave spectrometer capable of monitoring power absorptions as low as 10^{-16} watts. The assumption of pressure broadened spectral lines is completely validated by these measurements. In order to interpret the absorption spectra, the collision frequency velocity dependence was assumed to vary as $\nu_c = A + B\nu^h$ where A, B, and h are constants. The collision probability P_c was found to vary between values of 2050–2700 cm^{-1} $mm\ Hg^{-1}$ with a maximum value occurring at approximately 880°K. (auth)

20774 A SHOCK TUBE STUDY OF THE ELECTRIC POLARIZABILITY OF ATOMIC HYDROGEN. Wayland Clinton Marlow, III. Thesis, Stanford, Calif., Stanford Univ., 1963. 88p.

The dynamic electric polarizability of atomic H was measured by shock-heating a gaseous mixture of Ar and molecular H to temperatures causing nearly complete dissociation of the molecular H. The experimental work was supplemented by a theoretical analysis of both the static polarizability and the dynamic or frequency-dependent polarizability. The mean static polarizability was calculated for a high-temperature, completely dissociated, partially excited, and partially ionized medium of gaseous H, and the dynamic or high-frequency polarizability was calculated for the ground state and the first 2 excited states of atomic H. The dynamic polarizabilities of the excited states were found to be small compared to the static polarizabilities of the equivalent excited state, so that only the ground state, with possibly a small anomalous effect from the first excited state, would contribute to a measurement of the dynamic polarizability for wavelengths in the visible spectrum. The interferometric measurement of the fringe shift across the shock front of a shock traveling into a mixture of $\frac{2}{3}$ Ar and $\frac{1}{3}$ molecular H resulted in a value of the dynamic electric polarizability of the ground state of atomic H of $\alpha = (4.61 \pm 0.07)a_0^3$, for a wavelength of 5870 Å, where a_0 is the first Bohr radius. The present experimental value of the dynamic polarizability of the ground state of atomic H is in excellent agreement with the predictions of the quantum mechanical time-dependent perturbation theory. (Dissertation Abstr., 24: No. 8, Feb. (1964))

20775 CERENKOV RADIATION FROM ANISOTROPIC FERRITES. Fred Jerome Rosenbaum. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 122p.

The behavior of Cerenkov radiation generated by a spatially bunched, extended electron-beam passing through an anisotropic ferrite was evaluated as a function of the ferrite parameters. Three geometries were considered. An interaction resistance is defined in terms of the power radiated and is determined by solution of the appropriate electromagnetic boundary value problem. Numerical values for the interaction resistance as a function of the several system variables were obtained by programming the boundary value problems for solution by the digital computer ILLIAC. An extensive set of the theoretical results is presented graphically with interaction resistance displayed as a function of the several variables: precession frequency, magnetization frequency, beam velocity, beam radius, ferrite radius, ferrite permittivity, and outer dielectric region permittivity. Conditions for Cerenkov radiation in the ferrite are related to the propagation of plane-waves through the ferrite. These conditions are represented graphically in the frequency-propagation constant ($\omega - \beta_z$) plane. Interaction resistances of the order of 10^3 ohms per wavelength of interaction distance, the existence of a TM and a TE mode in the outer dielectric, and the behavior of the interaction with applied magnetic field are predicted by the theory and were verified by experiments with several different ferrites at X-band. Maximum generated powers of approximately one watt were observed using a 0.88 Mev electron-beam with a peak current of 18 ma. (Dissertation Abstr., 24: No. 9, March 1964)

20776 ENERGY TRANSFER ATTENDING COLLISIONS OF ATOMS WITH DIATOMIC MOLECULES. Alexander Keith Jameson. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 106p.

A study of vibrational energy transfer attending collisions of atoms with homonuclear diatomic molecules was carried out. A model obeying classical mechanics was assumed and calculations were carried out for various initial conditions. The potential energy for the three body system was taken to be the sum of three two-body potentials, namely: two Lennard-Jones potentials, representing the atom-molecule interaction, and one Morse potential, representing the diatomic molecule. Collisions studied were limited to the collinear variety and to perpendicular interactions in which the atom approached the center of mass of the molecule; in each instance the molecule possessed no rotational energy. The variables and parameters studied were translational and vibrational energies, vibrational phase angles, atomic and molecular masses, and molecular force constants. The resulting initial value problems were solved by numerical integration of the differential equations of motion on a digital computer, the Illiac. Comparison of the results, for no initial vibrational energy, with the analytical calculations of Rapp indicated agreement as to order of magnitude even though Rapp used an exponential repulsive potential. The energy transfer of collisions involving non-zero initial vibrational energy was analyzed in terms of a Fourier series in the vibrational phase angle. An arbitrary change was made in the phase angle to render the sum of the coefficients of the cosine terms equal to zero. For collinear hard sphere collisions the analytic calculation of energy transfer was expanded in a Fourier series and compared with the numerical calculations involving the more realistic Lennard-Jones interaction. Although the hard sphere analysis proved invalid, some Fourier coefficients had the same dependence on translational and vibrational energies. It was also found that the diatomic molecule was well represented by a harmonic potential function for initial vibrational energies below about one half the dissociation energy. The most interesting result was the comparison of the relative values of the energy transferred in collinear and perpendicular collisions. For heavy molecules and light atoms, collinear collisions are more important than perpendicular ones for large energy transfer. For light molecules and heavy atoms, on the other hand, perpendicular collisions are more important than the collinear variety for large energy transfer. Indeed, in some cases the relative values of the first Fourier coefficients of the sine series differed by an order of magnitude, with that for perpendicular being the higher of the two. (Dissertation Abstr., 24: No. 9, March 1964).

20777 A STUDY OF THE EJECTION OF ELECTRONS FROM THE SURFACE OF TUNGSTEN BY LOW ENERGY

IONS. Franklin Moore Propst. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 125p.

The total yields and energy distributions of electrons ejected from polycrystalline tungsten by the ions of helium, nitrogen, hydrogen, and oxygen were investigated. These quantities were determined for the ions of 50, 100, and 200 ev incident kinetic energy. The effect on the yields and energy distributions due to the adsorption of gases was also studied. Qualitative features of the experimental results are explained on the basis of theoretical models. The adsorption of hydrogen and nitrogen on the surface of tungsten apparently introduces localized electronic states at approximately 4.5 and 5.5 ev, respectively. The effect of adsorbed gases is explained in terms of the localized states. (Dissertation Abstr., 24: No. 9, March 1964)

20778 A PROPOSED MODIFICATION OF THE AVAILABLE MOMENTUM REGION IN THOMAS-FERMI THEORY. John Fayette Barnes. Thesis, Albuquerque, N. Mex., Univ. of New Mexico, 1963. 149p.

A "quantum correction" of the statistical model of the atom was obtained by modifying March and Plaskett's region of integration in the (n_r,l), or quantum number, plane. Integrations over the modified region produced a modified Thomas-Fermi expression for the electron density and a correction to the kinetic energy, which was named the "quantum-correction" energy. The measure of the correction of the region of integration is a so-called "modification factor." The modified density expression was utilized, with values of the modification factor appropriate to the pure Coulomb field of the nucleus, to investigate the correction of the electron-nuclear potential energy. It was shown that the latter is corrected from the erroneous Thomas-Fermi values within such a distance from the nucleus that the use of the Coulomb approximation is well justified. A modified Thomas-Fermi-Dirac equation was derived by the standard variational procedure. Numerical solutions of the equation were obtained, which yield atomic binding energies in much better agreement with experimental values than those of the unmodified theory. The pressure-compression values are only slightly different from those of the unmodified model. A method for more general determination of the modification factor than that based on a Coulomb field is also outlined, as well as the manner in which the modification could be extended to the nonzero temperature case. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20779 IONIZATION CROSS SECTION OF CESIUM IN THE NEAR THRESHOLD REGION. James Allen Michael. Thesis, Cleveland, Case Inst. of Tech., 1963. 66p.

The electron-impact ionization cross section of Cs in the near threshold region, i.e., impact energies up to ~8 times the threshold, was calculated by a modified Born approximation. The calculational technique, which was motivated by a desire to decrease the over-estimate produced by the Born approximation near the threshold, approximates the final state of the ejected electron by a plane wave orthogonalized to the atomic ground state. Since the final state of the "plane wave" Born approximation is orthogonal to any ground state, it was possible to use approximate ground states. This approach makes it attractive for calculations involving complex atoms. The ionization cross section of H was first calculated, and the result, when compared to other estimates, shows that, while the "plane wave" Born approximation tends to underestimate, relative to the experimental data, in the region up to twice the ionization potential, it is of comparable accuracy to other calculational techniques in the near threshold region. The calculated Cs cross section, which is the first reported quantum-mechanical estimate of this cross section, is in general agreement with previous estimates, although the tendency to underestimate near the threshold is again present. (Dissertation Abstr., 24: No. 8, Feb. 1964)

20780 AUGER-TYPE INTERACTION OF IONS WITH SOLID SURFACES AT LOW ENERGIES. H. D. Hagstrum and Y. Takeishi (Bell Telephone Labs., Murray Hill, N. J.). p.11-13 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The ion kinetic energy range at which Auger yield and ejected electron kinetic energy distributions may be measured was extended down to 4 ev. This experimental advance has made possible further studies of the physical broadening of the ejection process and the dependences on the characteristics of ion and solid. Experimental work was done on the atomically clean (111) faces of Ge and Ni. The characteristics of the process may now be extrapolated with considerable confidence into the thermal energy range. (auth)

20781 EMISSION OF ULTRAVIOLET RADIATION FROM METALS UNDER THE IMPACT OF HIGH ENERGY POSITIVE IONS. Rafi Mohammed Chaudhri, Mustafa Yar Khan, and M. Munawar Chaudhri (Government Coll., Lahore, West Pakistan). p.21-3 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Ultraviolet radiation emitted from Ag, Al, Cu, and W by the impact of hydrogen ions was studied with quartz window photomultiplier. It is found to be continuous in the region 2000–3400 Å. The intensity of the radiation from silver is maximum for wavelengths near 3200 Å while the Al radiation shows regular increase in intensity towards shorter wavelengths below 2500 Å. It is further observed that the metal ions of the defining slits ejected from them by high energy hydrogen ions also cause optical emission from the metal targets. (auth)

20782 MOMENTUM ACCOMMODATION ABOVE THE SPUTTERING THRESHOLD. Michel Bader and Howard F. Savage (Ames Research Center, Moffett Field, Calif.). p.25-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Momentum accommodation coefficients for N^+, N_2^+, and Ar^+ incident on Cu and Al were measured as a function of incident ion energy (0.5 to 4 kev) and angle of incidence (0 to 50° from the normal). The observed dependence of the accommodation coefficients on these parameters can best be explained by assuming that the incident ions are re-emitted from the surface with negligible energies and that all forces in excess of complete accommodation are due to the ejection of surface material (sputtering). (auth)

20783 ATOMIC SCATTERING FROM IONIC BOMBARDMENT OF METALLIC SURFACES. S. Datz and C. Snoek (F.O.M. Laboratorium voor Massascheiding, Amsterdam). p.27-9 of VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A study was made of the energy and angular distribution of the ions emitted and reflected from metallic surfaces (Cu, Ag, Au), when bombarded by an Ar^+ ion beam with energies ranging from 40 to 80 kev. It was found that the dynamical behavior of the ions could be described on the basis of biparticle collisions between the incoming argon ion

and a surface atom which is effectively isolated from lattice interactions. Two distinct groups of peaks were observed that could be easily differentiated on the basis of their energy dependence on scattering angle. One of these groups was attributable to scattered incident beam particles some of which were stripped of electrons (Ar^+ to Ar^{5+}), while the other group arose from ionized target atoms with charges ranging from 1+ to 5+. (auth)

20784 SPUTTERING OF COPPER BY ION BOMBARDMENT AT TARGET TEMPERATURES BETWEEN 40° AND 900°K. J. M. Fluit, J. B. Sanders, and C. Snoek (F.O.M. Laboratorium voor Massacheiding, Amsterdam). p.31-2 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A calculation of the range of focusing collision sequences in [110] directions, taking into account thermal vibrations, results in an average range of 5 atomic distances for copper at room temperature. This small number, which decreases for higher metal temperatures, enables us to correlate an almost temperature independent sputtering ratio between 150 and 900°K with the calculated decrease of range. Sputtering ratio measurements of copper between 40 and 150°K resulted in low sputtering ratios in two temperature intervals respectively below 150°K and below about 50°K. This is discussed in terms of accumulating interstitials, which also shortens the ranges. (auth)

20785 STUDY OF CATHODE SPUTTERING OF METAL CRYSTALS BOMBARDED WITH XENON IONS AT ENERGIES BETWEEN 25 AND 60 kev. K. Kopitzki, H.-E. Stier, O. Beer, and H. Beuscher (Universität, Bonn). p.33-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

Sputtering yields of Cu monocrystals bombarded with Xe^+ ions in different low-index-directions were measured as a function of incident ion energy (25 to 60 kev). The sputtering yield depends strongly on crystal orientation. The average kinetic energies of particles ejected in different low-index-directions from Cu, Zn, and W monocrystals bombarded with 25- to 60-kev Xe^+ ions were determined as a function of incident ion energy. The surprising difference between the average ejection energies for polycrystalline and monocrystalline W targets is probably a result of the influence of channelled trajectories. The velocity distribution of atoms ejected from a polycrystalline gold cathode was determined with a velocity selector. (auth)

20786 ON THE MASS DEPENDANCE OF SPUTTERING AT LOW BOMBARDING ENERGIES. H. Fetz and H. Oechsner (Universität, Würzburg, Ger.). p.39-42 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

Studying the influence of mass ratio m between the impinging and the sputtered particles on sputtering rate N, polycrystalline targets of Be, Ni, and Pt were bombarded by rare gas ions within the energy range from 20 to 1000 ev. Plotting yields over mass ratio m, in the lower part of the energy range N points out a maximum value at m = 1. With increased bombarding energy a pronounced shift of the maximum N to values m > 1 is found. To understand these results theoretical considerations were made assuming sputtering to be a complicated atomic collision process. Investigating sputtering below 100 ev lowest threshold energies are found for mass ratio one. (auth)

20787 AVERAGE ENERGY AND YIELD OF SPUTTERED ATOMS. C. H. Weijsenfeld (Rijksuniversiteit, Utrecht). p.43-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Mono- and polycrystalline targets were bombarded with ions from 10 to 2000 ev. The number of atoms sputtered normally to the target surface is deduced from the resistance change of the depositing metal film. With a simple differentiating circuit direct reading is possible. The energy of sputtered atoms is determined from the temperature rise of a thin mica foil collector. An atom flux of 10^{12} at./sec cm^2 with 1 ev/at. is still detectable. It is shown that the average energy of copper atoms sputtered in the ⟨110⟩ direction (4.5 ev/at.) is consistent with a focusing energy around 25 ev. (auth)

20788 VELOCITY DISTRIBUTION OF SPUTTERED ATOMS. G. K. Wehner and R. V. Stuart (General Mills, Inc., Minneapolis). p.49-50 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The question of velocities of sputtered atoms is of interest in sputtering theory, in radiation damage problems, and in thin film deposition. Earlier studies gave indications that the average ejection energies of sputtered atoms are much higher than those of vacuum evaporated atoms. This result was confirmed with a spectroscopic measuring technique which allows the determination of the distribution of velocities. The target is pulsed for 1 μsec to the negative bombarding voltage (up to 1200 volts) in a low-pressure, high-density plasma. The atoms sputtered during this pulse are ejected mostly as neutral, unexcited atoms. When these atoms enter into the dense magnetically concentrated plasma they find favorable excitation conditions and one can observe the emission spectrum of the ejected cloud of sputtered atoms. A monochromator which singles out a strong emission line of the target material is aimed at a small volume of dense plasma a fixed distance from the target. With a photomultiplier detector, one can then detect the arrival of sputtered atoms in the observation volume. Counting the number of photons which appear in a 1-μsec interval (which is shifted from 0 to 300 μsec with respect to the target pulse) yields the time distribution of sputtered atoms. From this, one readily obtains the velocity or energy distribution. A typical result for the energy distribution of atoms ejected in a [110] direction normal to the surface of a Cu (110) single crystal plane bombarded with Kr^+ ions of various energies is shown. (auth)

20789 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI." COURSE XXI. LIQUID HELIUM. VARENNA ON LAKE COMO. VILLA MONASTERO. JULY 3-JULY 15, 1961. G. Careri, ed. New York, Academic Press, 1963. 448p. $16.00.

Twenty papers are presented on liquid helium with emphasis on theory. Some contemporary aspects are included. Individual abstracts are prepared for eighteen. Abstracts of two papers appeared in NSA as 16: 4605 and 25911. (L.B.S.)

For abstracts of individual papers see: 20790, 20791, 20792, 20793, 20794, 20795, 20796, 20797, 20798, 20799, 20800, 20801, 20802, 20803, 20804, 20805, 20806, and 20807.

20790 EXCITATION MODEL FOR LIQUID HELIUM II. J. de Boer (Universiteit, Amsterdam). p.1-50 of "Liquid Helium." New York, Academic Press, 1963.

The excitation model for liquid helium II is developed in five chapters. The first discusses the thermodynamic

properties, including the quantum effect on reduced energy, caloric properties and thermal expansion curves. The phenomenological theory of the two-fluid model is developed in chapter II. Chapter III deals with the basic excitations that occur in liquid helium II and their properties. The dispersion relations, describing the dependence of the energy of a single excitation on its momentum, are developed. The system of liquid helium in equilibrium and the method of calculating the macroscopic properties of the system by the ensemble method of statistical mechanics, leading to the partition function, are discussed in chapter IV. The concept of local distribution functions is used for the case of liquid helium in a nonequilibrium state and the reversible equations of transport for momentum and energy are derived in chapter V. Finally, irreversible transport phenomena, solving the Boltzmann equation for these cases, are treated in chapter VI. (L.B.S.)

20791 SUPERFLUIDITY. G. V. Chester (Univ. of Birmingham, Eng.). p.51-92 of "Liquid Helium." New York, Academic Press, 1963.

A variational method is used in discussing the experimentally known spectrum of elementary excitations and the motion of impurities in liquid helium. The detailed properties of the variational wave functions are discussed. Chapter II discussed some of the basic physical and theoretical ideas connected with superfluidity with application of Landau's criterion to various systems. The two-fluid model is interpreted using Feynman's wave functions in chapter III. The question of whether Bose-Einstein condensation occurs in liquid helium and its connection with superfluidity is discussed in chapter IV. The present state of the theory of quantum vortices is discussed in the final chapter. (L.B.S.)

20792 THEORY OF LIQUID ^{3}He. A. M. Sessler (Ohio State Univ., Columbus). p.188-292 of "Liquid Helium." New York, Academic Press, 1963.

The basic ideas and concepts of the theory of liquid ^{3}He are reviewed. The discussion is limited to the liquid at low temperatures where the concept of a quasi-particle is valid. Some basic results of statistical mechanics are reviewed, and the ideal Fermi gas is discussed, followed in part II by the phenomenological theory as first developed by Landau. Part III discusses the microscopic approach. The second quantization formalism is developed without assuming a knowledge of field theory. The theory of the ground state is then discussed and finally, the formalism of Green's function and spectral representations are used in the development of statistical mechanics. In part IV, the possibility that the ground state of the liquid is a highly correlated state is described, along with some properties of the predicted low temperature phase. (L.B.S.)

20793 THE NATURE OF THE λ-TRANSITION IN LIQUID HELIUM. W. M. Fairbank (Stanford Univ., Calif.). p.293-304 of "Liquid Helium." New York, Academic Press, 1963.

Two experiments, which relate indirectly to the problem of long-range order in momentum space in liquid helium, are described. The first is the measurement of the specific heat of liquid helium to within one-millionth of a degree of the λ point. A plot of the specific heat vs $T-T_\lambda$ indicates a logarithmic dependence which extrapolates to logarithm singularity at the λ point. The second experiment demonstrates that magnetic flux is quantized in a superconducting cylinder. (L.B.S.)

20794 VORTICITY IN THE HELIUM FILM. J. F. Allen (St. Andrews Univ., Fife, Scotland). p.305-14 of "Liquid Helium." New York, Academic Press, 1963.

Critical velocities, motion, and transfer rate of helium films are discussed. Damping of isothermal film oscillations at temperatures between 1.2 and 1.9°K was studied and the critical angle of surface tension in liquid helium was determined. (L.B.S.)

20795 ON THE THEORY OF HELIUM FILM. S. Franchetti (Università, Florence). p.315-25 of "Liquid Helium." New York, Academic Press, 1963.

The equation of the film for the static case under saturated conditions was derived. The unsaturated case was briefly discussed. (L.B.S.)

20796 EQUATIONS OF MOTION FOR ROTATING HELIUM II. H. E. Hall (Univ. of Manchester, Eng.). p.326-35 of "Liquid Helium." New York, Academic Press, 1963.

The equations of motion for rotating helium II are derived from the vortex line model using the microscopic approach. The derivation of Bekarevich and Khalatnikov, using a phenomenological approach, is presented. The experimental evidence for the existence of the various additional terms in the equation of motion is discussed and brief remarks are given on the applicability of the equations to turbulent flow. (L.B.S.)

20797 CRITICAL VELOCITIES IN LIQUID HELIUM II. W. F. Vinen (Cambridge Univ., Eng.). p.336-55 of "Liquid Helium." New York, Academic Press, 1963.

Ideal and nonideal supercritical velocities are discussed under the assumption that the supercritical frictional forces originate from turbulence in the superfluid, the turbulence taking the form of a tangled mass of quantized vortex lines. In the ideal type, the subcritical flow of superfluid contains no vortex lines, the flow being purely potential. In the nonideal type, the subcritical flow does contain vortex lines, either in the form of a uniform array or a turbulent tangle of low density. (L.B.S.)

20798 LIQUID HELIUM II HEAT CONDUCTIVITY AND FOUNTAIN PRESSURE: MEASUREMENTS AND CALCULATIONS FOR NARROW SLITS. E. F. Hammel, W. E. Keller, and P. P. Craig (Los Alamos Scientific Lab., N. Mex.). p.356-69 of "Liquid Helium." New York, Academic Press, 1963.

An experiment in which the heat conductivity and associated fountain pressure is measured for three small slit widths is described. The heat current data for the 3.36 μ slit are reported as a family of curves for each cold temperature, and corresponding data for the formation pressures are presented. The results of direct fountain pressure measurements for the 0.276 μ slit agree with those obtained from the London fountain pressure equation. Data for the 2.12 and 3.36 μ slits are analyzed systematically for regions over which the slit behavior is linear and nonlinear by the London-Zilsel hydrodynamic equation and the Gorter-Mellink equation, respectively. (L.B.S.)

20799 THE APPEARANCE OF FRICTION IN SUPERFLUID HELIUM. K. Mendelssohn (Oxford Univ.). p.370-8 of "Liquid Helium." New York, Academic Press, 1963.

Observations of flow initiated by pressure and temperature gradients in tubes up to about a millimeter in diameter and 50, 100, and 150 cm in length were made to study the friction in superfluid helium. It is concluded that the onset of friction is primarily due to the appearance of turbulence, which sets in when the superfluid exceeds a certain critical velocity relative to the walls of the tube. (L.B.S.)

20800 LAMINAR AND TURBULENT FLOW OF He-II IN WIDE CAPILLARIES. K. W. Taconis and F. A. Staas (Kamerlingh Onnes Laboratorium, Leiden). p.379-83 of "Liquid Helium." New York, Academic Press, 1963.

Three flow methods were used to study the flow behavior at low and high velocities. The apparatus and methods are described with special emphasis on the overflow method. Log-log plots of the pressure difference against the velocity in terms of Reynolds numbers yield straight lines under 45° for laminar flow and a straight line obeying the equation of Blasius for turbulent flow. (L.B.S.)

20801 DILUTE MIXTURES OF ^{3}He IN SUPERFLUID ^{4}He. J. J. M. Beenakker and R. de Bruyn Ouboter (Kamerlingh Onnes Laboratorium, Leiden). p.384-99 of "Liquid Helium." New York, Academic Press, 1963.

Measurements of specific heat of ^{3}He–^{4}He mixtures at various concentrations show, between 0.4 and 1°K, an almost constant contribution of ^{3}He to the specific heat. Thermodynamic properties are investigated and compared with theory. (L.B.S.)

20802 SECOND SOUND AND DISSIPATIVE PROCESSES IN VERY DILUTE ^{3}He–^{4}He MIXTURES. H. C. Kramers (Kamerlingh Onnes Laboratorium, Leiden). p.391-402 of "Liquid Helium." New York, Academic Press, 1963.

Experimental results obtained from observations of heat pulses propagated through liquid mixtures are discussed for the temperature range between 0.1 and 1°K and concentrations below 1% ^{3}He. The effective thermal conductivity deduced from second sound attenuation shows good agreement with theory for temperatures above 0.5°K. (L.B.S.)

20803 THE NATURE OF IONS IN LIQUID HELIUM. K. R. Atkins (Univ. of Pennsylvania, Philadelphia). p.403-13 of "Liquid Helium." New York, Academic Press, 1963.

The dependence of the mobility of helium ions on temperature, pressure, and electric field is discussed. The density of liquid in the vicinity of the He ion is discussed using the electrostriction model. (L.B.S.)

20804 THE STRUCTURE AND THE MOBILITY OF IONS IN LIQUID HELIUM. C. G. Kuper (St. Salvator's Coll., St. Andrews, Scotland). p.414-22 of "Liquid Helium." New York, Academic Press, 1963.

Helium atoms are considered as hard spheres with van der Waal's attractions outside the core radius and hard core interactions between ion and neutral atoms. Atkin's theory is assumed to be correct in describing the structures of the positive and negative ions. It is shown that the scattering cross sections predicted on the basis of the electrostriction model for the positive ion and the bubble model for the negative ion are in reasonable accord with experiment. The behavior of ions under pressure and in the presence of high electric fields is also discussed. (L.B.S.)

20805 IONS IN LIQUID HELIUM. SOME CONTEMPORARY ASPECTS. G. Careri (Università, Rome). p.423-6 of "Liquid Helium." New York, Academic Press, 1963.

The problems concerning behavior of ions in liquid helium are presented. Remarks on the present state of experiment and theory for the nature of the ions, properties of the ionic plasma, the interaction of the ions with the equilibrium excitation gas, hot ions, and the interaction with the vorticity are given. (L.B.S.)

20806 PROPERTIES OF LIQUID ^{3}He BELOW 1°K. H. A. Fairbank (Yale Univ., New Haven). p.427-35 of "Liquid Helium." New York, Academic Press, 1963.

Theoretical predictions of the Fermi liquid theory, on the possibility of superfluidity, and of the theory developed by Brueckner and Gammel, in which the properties of the quasi-particles are determined in terms of two-body forces between the atoms, are presented. Results are given from measurements of specific heat, nucleic magnetic susceptibility, thermal conductivity, coefficient of self diffusion, viscosity, thermal boundary resistance, and coefficient of thermal expansion. (L.B.S.)

20807 PROPERTIES OF ^{3}He NEAR THE MELTING CURVE. D. F. Brewer (Oxford Univ.). p.436-42 of "Liquid Helium." New York, Academic Press, 1963.

Measurements of the melting curve at temperatures between 0.06°K and 1°K at pressures of 30 to 40 atm and up to 31°K at pressure of ~3400 atm are investigated. Phase diagrams of ^{4}He and ^{3}He at low temperatures are shown. Solid and liquid properties including compressibility, expansion coefficient, and change in volume on melting are discussed. (L.B.S.)

20808 ENERGY MINIMUM PRINCIPLE FOR HARTREE-FOCK CALCULATIONS OF CERTAIN EXCITED ATOMIC STATES. J. F. Perkins (Army Ordnance Missile Command, Redstone Arsenal, Ala.). 7p. (CONF-481-14)

From American Physical Society Annual Meeting, New York, Jan. 1964.

It is shown that the energy minimum principle applies to Hartree-Fock calculations of a large number of optical states without the necessity of requiring the trial function to be orthogonal to the exact wave functions of lower states of the same symmetry. This property follows from the stationary-energy requirement of the Hartree-Fock method. (C.E.S.)

20809 NEW TABLES OF THE PARAMETERS FOR ATOMIC SCATTERING FACTORS ACCORDING TO FORSYTH-WELLS APPROXIMATION. Sukeaki Hosoya and Seiya Satake (Tokyo Univ.). 15p. (CONF-483-1)

From Crystallography Society of Japan Annual Meeting, Tokyo, Oct. 1963.

Numerical tables of parameters for atomic scattering factors were prepared according to Forsyth-Wells approximation, using the data all taken from International Tables for X-ray Crystallography. The data used are more recent and reliable than those used by Forsyth and Wells. The tables include two series of parameter values, one for Cu range and the other for Mo range. (auth)

20810 ION AND CHARGE EXCHANGE REACTIONS INVOLVING ATMOSPHERIC GASES. J. Sayers and D. Smith (Univ. of Birmingham, Eng.). 9p. (CONF-462-3).

From The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

In order to study reactions between ions and neutral particles, a series of experiments were carried out that utilize time resolving mass-spectrometric monitoring of the afterglows in atmospheric gases produced by radio-frequency discharges. Reactions investigated were: the charge exchange rates of the O^+ ion with oxygen and nitrogen; and the charge exchange rates of the He^+ ion with oxygen and nitrogen. Rate coefficients and cross-sections are presented for some of the reactions, together with suggestions concerning the mechanism of the reactions. (auth)

20811 INVESTIGATION OF NEUTRAL Cu AND Cu_2 SPUTTERED FROM POLYCRYSTALLINE Cu BY LOW-ENERGY Ar^+ AND Ar^{++}. C. Burleigh Cooper and James R. Woodyard (Univ. of Delaware, Newark). 7p. (CONF-481-27)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The yield dependence on incident ion energy was determined for neutral Cu and Cu_2 sputtered from polycrystalline Cu by Ar^+ and Ar^{2+} at energies of 20 to 100 ev. (C.E.S.)

20812 RANGE OF Xe^{125} IONS OF kev ENERGIES IN MONOCRYSTALLINE Si. J. A. Davies. 10p. (CONF-481-8)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The mean range of ^{125}Xe ions in silicon single crystals was determined for bombarding energies of 20 to 80 kev. The anodizing-stripping process was used for silicon layer removal. (C.E.S.)

Cosmic Radiation

Refer also to abstract 20720.

20813 (AD-434176) THE MODULATION OF HEAVY NUCLEI IN THE PRIMARY COSMIC RADIATION. Technical Report CR-70. P. S. Freier and C. J. Waddington (Minnesota. Univ., Minneapolis. School of Physics). Feb. 1964. Contract Nonr-710(91). 31p.

The intensities of the primary cosmic ray heavy nuclei, $Z \geq 3$, have been studied during several Forbush decreases. Fifteen values of the intensity were measured using nuclear emulsion detectors flown during a balloon cosmic ray monitoring program. These values are those observed before, during or after four of the largest Forbush decreases that occurred in the last solar cycle. Examination of this data, together with that previously available in the literature suggests that the heavy nuclei are modulated in a similar manner to the α particle and protons of the primary radiation, showing that the modulation process is not a strongly charge dependent one. (auth)

20814 (AD-434540) TIME VARIATIONS IN COSMIC RAYS AND RADIOSONDE MEASUREMENTS. Final Technical Report. Ismael Escobar (Universidad Mayor de "San Andres," La Paz, Bolivia. Laboratorio de Fisica Cosmica de Chacaltaya). June 1963. Contract AF-AFOSR-62-395. 105p.

Theory for the relation of cosmic ray intensity variation to the solar wind and the associated interplanetary magnetic field variations is discussed in relation to experimental data. Data on the quiet-day solar diurnal variation of cosmic rays indicate that solar wind velocity is usually above 100 km/sec and that the wind velocity undergoes a 22-year cyclic change. Also it is demonstrated that the shift to earlier hours of the time of maximum of disturbed day solar diurnal variation observed during early stages of the cosmic ray storms permits a selection between Parker's blast wave model and the magnetic tongue model advocated by Gold for the configuration of interplanetary magnetic field obtainable on geomagnetically disturbed days. Observations fit the blast wave model better. A qualitative model in which solar wind plays a major role, is presented to explain the gross features of the secular variation of isotropic intensity of cosmic rays in terms of currently accepted ideas. The model requires that the interplanetary magnetic field should extend over a distance amounting to several tens of A.U. from the sun. The results of an attempt to calculate the configuration of solar plasma in space at the time of a solar flare are also presented, together with meteorological data obtained with radiosonde equipment at Ouejuyo at 30,000 M. 40 references. (auth)

20815 (BNL-7948) THE TEMPORAL AND SPATIAL VARIATION IN COSMIC RAYS. O. A. Schaeffer, R. Davis, Jr., R. W. Stoenner, and D. Heymann (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 8p. (CONF-320-2)

From International Conference on Cosmic Rays, Jaipur, India, Dec. 1963.

The ratios $^{39}Ar/^{36}Cl$ in five dated fall meteorites were determined and compared with a production cross section ratio obtained from production measurements with iron targets. The results indicate that the average intensity of cosmic rays during the last million years was the same, within 10% of the average value during the last thousand years. Determination of the $^{37}Ar/^{39}Ar$ activity ratio in recently fallen meteorites and comparison with production cross sections measured with high-energy protons and alpha particles indicated that there is a 10 to 20% gradient in cosmic-ray intensity in space between the earth and a point some hundreds of kilometers further from the sun. Also, intense solar flares seem to produce measurable effects on meteorites. (D.C.W.)

20816 PHOTON FLUXES ALONG LOW-ACCELERATION TRAJECTORIES THROUGH THE VAN ALLEN BELT. Frank J. Hrach (Lewis Research Center, Cleveland). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 762-4(Apr. 1964).

An estimate is made of the time-integrated proton flux for trajectories having a constant acceleration in the range of 5×10^{-4} to 10^{-2} m/sec^2 and an angle between the vehicle orbit plane and the equatorial plane of 0 to 90°. (R.E.U.)

20817 PRODUCTION OF CARBON 14 BY SOLAR PROTONS. R. E. Lingenfelter and E. J. Flamm (Univ. of California, Los Angeles). J. Atmospheric Sci., 21: 134-40 (Mar. 1964).

The rate of production of carbon-14 by interaction of solar-proton-produced neutrons with atmospheric nitrogen is calculated for the period 1956-61. A time-average production rate of 0.05 to 0.12 carbon-14 atoms cm^{-2} sec^{-1}, less than 5 per cent of the rate of production by galactic cosmic-ray neutrons, is obtained. Solar particle radiation of the intensity observed during the last solar cycle increases the neutron flux at high altitudes by more than an order of magnitude for short periods but does not significantly affect the atmospheric reservoir of carbon-14. (auth)

20818 ON THE RELATION BETWEEN THE LATITUDE DEPENDENCE AND THE MAGNITUDE OF COSMIC-RAY STORMS. Hachiro Takahashi (Iwate Univ., Japan). J. Geomagnet. Geoelec., 15: 117-25(1964).

A statistical study of the relation between the latitude dependence and the magnitude of cosmic storms is presented. World-wide cosmic-ray neutron data obtained at mountain altitudes during the I.G.Y. are used, and the intensity of cosmic rays at the time of cosmic-ray storms were corrected for the effect of the storm-time intensity increase. The magnitude of the latitude dependence of cosmic-ray storms, associated with geomagnetic storms less than about 150 γ, is greater in the cases of the cosmic-ray storms accompanied by the larger geomagnetic storms than the smaller ones within the 150 γ range of geomagnetic storms. For cosmic-ray storms associated with geomagnetic storms larger than about 150 γ, the magnitude of the latitude dependence of cosmic-ray storms is nearly constant regardless of the magnitude of associated geomagnetic storms. Results are interpreted by the effect of an attenuation of the energy spectrum of primary cosmic rays due to an incoming magnetized cloud during cosmic-ray storms. (auth)

20819 ANISOTROPY OF PRIMARY COSMIC RADIATION AT THE EARTH. S. Standil and R. P. Bukata (Univ. of Manitoba, Winnipeg, Can.). Phys. Rev. Letters, 12: 487-90(Apr. 27, 1964).

Variations in the cosmic meson (μ) counting rate with direction were observed. It is proposed that this directional variation is indicative of a large anisotropy of the responsible primary cosmic rays arriving at the earth and that this is a result of their interaction with the inner solar system. (C.E.S.)

20820 SOLAR NEUTRONS AND THE EARTH'S RADIATION BELTS. R. E. Lingenfelter and E. J. Flamm (Univ. of California, Los Angeles). Science, 144: 292-4 (Apr. 17, 1964).

The intensity and spectrum of solar neutrons in the vicinity of the earth were calculated on the assumption that the low-energy protons recently detected in balloon and satellite flights are products of solar neutron decay. The solar-neutron flux thus obtained exceeds the global average cosmic-ray neutron leakage above 10 Mev, indicating that it may be an important source of both the inner and outer radiation belts. Neutron measurements in the atmosphere are reviewed and several features of the data are found to be consistent with the estimated solar neutron spectrum. (auth)

20821 PROCEEDINGS OF THE INTERNATIONAL SCHOOL OF PHYSICS "ENRICO FERMI." COURSE XIX. COSMIC RAYS; SOLAR PARTICLES AND SPACE RESEARCH. VARENNA ON LAKE COMO. VILLA MONASTERO. MAY 23–JUNE 3, 1961. B. Peters, ed. New York, Academic Press, 1963. 427p. $16.00.

Four papers not abstracted are on type IV solar radio emission, Kiruna geophysical observatory, radioastronomy programs in Italy, and international agreement in space research. Twenty-one papers are abstracted for this issue. Three papers were previously abstracted in NSA as numbers 15: 29866, 16: 26052, and 17: 12988. (M.J.T.)

For abstracts of individual papers see: 20410, 20411, 20412, 20721, 20722, 20723, 20724, 20725, 20726, 20822, 20823, 20824, 20825, 20826, 20827, 20828, 21087, 21088, 21089, 21090, and 21091.

20822 MOTION OF COSMIC RAY PARTICLES IN THE GEOMAGNETIC FIELD. H. Elliot (Imperial Coll. of Science and Tech., London). p.16-27 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The dipole nature of the internal geomagnetic field is discussed. The existence of allowed and forbidden regions leads to an expression for minimum rigidity for cosmic particles to reach the earth. Observed exceptions are explained by non-dipole terms and postulated external current systems. In particular, ring currents produced by plasma trapped in the field cause field distortion and thus lowering of minimum rigidity. An experimental model to derive rigidity thresholds is briefly described. (M.J.T.)

20823 ACCELERATION OF COSMIC-RAY PARTICLES BY MAGNETIC PUMPING. C.-G. Faelthammar (Royal Inst. of Tech., Stockholm). p.99-112 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The magnetic-pumping mechanism is described. The particle distribution equation is derived and is solved for a point source and space independent acceleration and diffusion. Alfvén's model for the origin and spectrum of cosmic rays follows from this solution. (M.J.T.)

20824 THE PRIMARY COSMIC RADIATION. C. J. Waddington (Univ. of Bristol, Eng.). p.135-86 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Charge, energy, and spatial distributions of primary cosmic radiation are described in terms of their variations with atomic number and particle rigidity. The significance of this experimental knowledge for theories of cosmic ray origin is discussed. Experiments to clarify present uncertainties are suggested. (M.J.T.)

20825 EXTENSIVE AIR SHOWERS. L. Scarsi (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). p.194-9 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Extensive air showers were studied to gain information on primary cosmic radiation—its arrival direction, composition, and origin. The M.I.T. experiments at Volcano Ranch, New Mexico, are described. Preliminary results show that there is no primary cosmic ray cut-off up to at least 10^{19} ev. Thus an extra-galactic origin is implied. (M.J.T.)

20826 ELECTRONS IN THE GALACTIC COSMIC RADIATION. B. Dayton (Universitet, Copenhagen). p.200-10 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Cosmic radio emission and possible mechanisms producing it, in particular electron synchrotron radiation, are discussed. Two recent experiments measuring primary cosmic ray electrons are evaluated. The requirements of a critical experiment are listed, and an electron detector for this experiment is proposed. (M.J.T.)

20827 ON THE ORIGIN OF COSMIC RAYS. F. Hoyle (Cambridge Univ., Eng.). p.293-319 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The orthodox theory of cosmic ray origin in the galaxy and galactic halo is reviewed. A less orthodox point of view, arising from the radio-spectrum difficulty and allowing escape from the galaxy, is presented. Cosmic rays of solar origin are then considered. (M.J.T.)

20828 COSMIC-RAY MEASUREMENTS IN THE U.S./U.K. SATELLITE S-51. H. Elliott (Imperial Coll. of Science and Tech., London). p.392-401 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The cosmic ray spectrum will be investigated by measuring intensities of nuclei with $Z \geq 6$. Sensor structure and electronics, Cherenkov and Geiger detectors, power supply, data storage, and mechanical structure of the probe are described. (M.J.T.)

Direct Energy Conversion

20829 (AD-429503) THE DEVELOPMENT OF A LOW-WORK-FUNCTION COLLECTOR FOR THERMIONIC ENERGY CONVERTERS. Annual Technical Summary Report No. 1, December 15, 1962–December 15, 1963. W. B. Hall and R. J. Hill (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Contract NONR-4012(00)-FBM. 70p.

The construction and evaluation of a unique device for studying collectors of thermionic converters operating in the "Ball-of-Fire" mode are described. The test vehicle contains one emitter and a rotating disc on which six collectors are mounted. Without disturbing the vacuum con-

dition, each collector may in turn be brought adjacent to the emitter and the electrode combination can be operated as a converter. The emitter temperature, collector temperature, cesium reservoir temperature, and interelectrode spacing may all be independently varied and measured. Preliminary data for the first set of collectors evaluated in this device are presented indicating that arc-cast tungsten produces the highest power and polycrystalline molybdenum produces the highest voltage at the highest power. (auth)

20830 (AD-432464) LONG-LIFE CLOSED LOOP MHD RESEARCH AND DEVELOPMENT UNIT. Interim Scientific Report No. 8, December 15, 1963–February 29, 1964. (Westinghouse Electric Co., Pittsburgh). Mar. 3, 1964. Contract AF33(657)-8311. 48p.

The Closed Loop MHD Research and Development Unit is in the final stages of preparation for the next test. Several minor modifications were made in the overall system. Modifications were primarily concerned with decreasing the heat losses from the system and increasing the heat input to the system so as to permit operation with working fluids at higher temperatures. Other modifications include instrumentation additions and refinements. A new closed loop duct with ceramic lined end returns was partially fabricated. (auth)

20831 (APL-TDR-64-28) KRYPTON-FILLED THERMIONIC CONVERTER. G. G. Fee and R. Forman (Union Carbide Corp. Parma Research Lab., Ohio). Mar. 31, 1964. Contract AF33(657)-10131. 92p.

Inert gas-filled thermionic diodes operating in the high radiation field of a nuclear reactor were evaluated. In this concept, space charge neutralization is accomplished with positive ions generated by the nuclear radiation. Glass diodes (68) containing Philips impregnated cathodes (operating temperature 1100°C) were tested in the core of a 5-Mw swimming pool reactor. Gases investigated included Ar, Kr, and Xe over the pressure range of 1 to 200 torr. In addition, interelectrode spacing, radiation dose rate and anode material were varied. Although a design goal of 5 w was contemplated, the maximum power generated with any of these diodes was <0.25 w. The primary reason for this low power was the inability to develop an anode with a work function of <2.1 ev when operated in a system containing a Philips cathode. Experiments were also run with low output converters (<4 microwatts) filled with radioactive krypton. Such diodes exhibited negative resistance and could be made to oscillate anywhere in the range of 50 to 10×10^6 cycles. These experiments were designed to study the feasibility of adapting this concept as a low power a-c generator. (auth)

20832 (GA-4511) HIGH-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER. Quarterly Technical Progress Report for the Period Ending July 31, 1963. R. Skoff (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 26, 1963. Contract AF33(657)-8563. 22p. (AD-417574)

Efforts were directed to the evaluation of materials, fabrication, and testing problems associated with the operation of high-temperature vapor-filled thermionic converters employing uranium-zirconium carbide emitters of cylindrical geometry. To date five of these converters have operated 5300 hr. Cell H, which had two cesium vials, was placed in operation, while final assembly of Cell K was completed. Cell H output was 56 watts at an emitter temperature of 2380°K. The cesium temperature optimum for maximum power was 637°K. A collector temperature optimum was not obtained due to cooling limitations. (auth)

20833 (GA/PHYS/63-11, 12) THE ELECTRICAL CHARACTERISTIC OF AN ELECTROHYDRODYNAMIC GENERATOR FOR AN ALTERNATING INPUT (thesis). John Paul Sutherland (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1963. 140p. (AD-419057)

The electrohydrodynamic generator investigated transforms kinetic energy from a high-velocity airstream into recoverable electrical energy by transporting corona discharge ions against an electric field. Theoretical and experimental investigations of the electrical characteristics of the generator were conducted for alternating inputs. The feasibility of alternating current power generation was demonstrated, optimum input wave shape and ranges of load resistance and frequency determined, and self-sustained oscillation hypothesized. The output capacitance of the generator proved to be the limiting factor in the experimentation. (auth)

20834 (NP-13808) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. First Quarterly Technical Progress Report, September 1, 1963–November 30, 1963. W. D. Jackson, G. A. Brown, J. L. Kerrebrock, and E. N. Carabateas (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Contract AF33(616)-1083. 33p.

The development, theory, design, fabrication, and testing of two forms of closed-cycle magnetohydrodynamic power-generation systems and cesium thermionic converters are investigated. Topics covered include: magnetohydrodynamic power generation with liquid metals, liquid-metal magnetohydrodynamic generators, electrical conductivity of two-phase liquid-metal flow, magnetohydrodynamic channel flow, systems with alkali-metal vapor generators, studies of transport phenomena in cesium thermionic converters, electron and ion emission from different crystallographic orientations in vacuum and cesium, measurements of thermal conductivity in cesium gas, studies of surfaces, electron and ion emission from a tungsten monocrystal, and penetration of an ion through an ionic dipole layer at an electrode surface. (N.W.R.)

20835 (NP-13814) DESIGN, DEVELOPMENT, AND TEST OF A PROTOTYPE SELF-EXCITED MHD GENERATOR. Semi-Annual Technical Summary Report. (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Sept. 1963. Contract AF33(657)-8380. 40p.

Fabrication, assembly, and testing of the various generator components and their auxiliary systems is reported. Modifications to the burner components, mainly the injector assembly, are described. Tests showed that the safety factor on burnout was too small for the cooling water system in the pilot burner; therefore the problem was solved by lowering the enthalpy of the combustion gases by dilution with nitrogen. Modifications are also made of the pilot burner control system, main fuel system, and oxygen system. An instrumentation system is described for measuring generator performance and monitoring the functioning of the control system. Construction of generator components and auxiliary systems has reached the point where some testing can be started and the status of such testing is reported. (N.W.R.)

20836 (R61SD066) DETERMINATION OF THE LONGITUDINAL VARIATION OF MHD CHANNEL CROSS SECTION FOR MAXIMUM POWER. Hsuan Yeh (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Apr. 1961. Contract AF49(638)-914. 18p. (AFOSR-1030)

The analysis is based on the one-dimensional inviscid flow equations of an ionized gas (the electrical conductiv-

ity of which is generally a function of pressure and temperature) flowing through a channel to generate electrical power. The distribution of channel cross section (and hence of all other gas properties) for maximum power generation with given inlet conditions and fixed channel length is obtained. A procedure based on the method of steepest descent is used. The procedure is formulated for the general case, and a simplification is obtained by assuming that the conductivity varies with temperature according to a power law. The method is tested by calculating the first variation, using the constant-velocity distribution as the zero approximation. (auth)

20837 THE THERMIONIC ELEMENT AND ITS SIGNIFICANCE FOR SPACE NAVIGATION. R. Langpape (Brown, Boveri and Cie, AG, Mannheim, Ger.). Atomwirtschaft, 9: 121-5(Mar. 1964). (In German)

The application of thermionic elements in combination with suitable heat sources, for example a high temperature reactor, for the generation of power in a space vehicle is discussed. The most promising device at the moment is considered to be the cesium diode. Its efficiency in laboratory experiments is 14 to 16% but this may probably be increased to about 20%. A single element supplies some hundred watts at a voltage of about 1 volt and a power density of 5 to 10 watts/cm^2. A higher output voltage is obtainable by connecting several elements in series. The life of cesium diodes should amount to at least 10,000 hours. The weight/power ratio of a 500 kw generator for space vehicles consisting of a reactor (without shielding), thermionic elements, circulatory cooling system, and radiator cooler is estimated at about 5 kp/kw. In addition to experimental apparatus, which is still predominantly electrically heated, experiments in reactors were carried out. Several thermionic reactors are being developed in the United States. The design work on a 60 and a 300 kw reactor with thermionic elements was completed and an installation for 2,000 kw is planned. The construction, mode of action, efficiency, power density, incorporation into reactors, significance for space navigation, and the state of the art of thermionic elements are reviewed. (auth)

20838 MHD: ITS FUTURE POTENTIAL. W. S. Emmerich (Westinghouse Electric Corp., Pittsburgh). Energy Intern., 1: No. 2, 14-17(Apr. 1964).

The basic theory and applications of MHD power generation are discussed. (R.E.U.)

20839 THE MAGNETOGASDYNAMIC CONSTANT MACH NUMBER DUCT EQUATIONS. Bernard Durney (Compagnie Generale de Telegraphie Sans Fil, Orsay, France). Z. Angew. Math. Phys., 15: 62-6(1964).

It is shown that the constant Mach number duct equations for magnetogasdynamic power generation can be explicitly integrated if the transformation of variable $\xi = \int_0^x (\sigma AB^2/G)\, dx$ is performed. (M.C.G.)

20840 INVESTIGATION OF THE VOLTAGE-CURRENT CHARACTERISTICS AND CURRENT OSCILLATIONS IN LOW-PRESSURE THERMIONIC CONVERTERS. V. Ya. Karakhanov, R. Ya. Kucherov, and D. G. Tatishvili. Zh. Tekhn. Fiz., 34: 326-32(Feb. 1964). (In Russian)

Experimental studies were made of thermionic cell plasma oscillations. The influence of the oscillations on volt-amp characteristics is evaluated. It is shown that the oscillations always reduce diode current and are observed with both positive and negative cathode field. (tr-auth)

20841 REPORT OF THE THERMIONIC CONVERSION SPECIALIST CONFERENCE, OCTOBER 7-9, 1963, GATLINBURG, TENNESSEE. Available from J. M. Houston, General Electric Research Lab., P. O. Box 1088, Schenectady, N. Y. 1963. 381p. $15.00.

Plasma physics and converter diagnostics, surface physics, materials and compatibility studies, and applied converter technology are discussed. Separate abstracts are prepared for 49 of the 51 papers presented. Two papers previously appeared in NSA (17: 7457 and 12850). (C.E.S.)

For abstracts of individual papers see: 20772, 20773, 20842, 20843, 20844, 20845, 20846, 20847, 20848, 20849, 20850, 20851, 20852, 20853, 20854, 20855, 20856, 20857, 20858, 20859, 20860, 20861, 20862, 20863, 20864, 20865, 20866, 20867, 20868, 20869, 20870, 20871, 20872, 20873, 20874, 20875, 20876, 20877, 20878, 20879, 20880, 20881, 20882, 20883, 20884, 20885, 20886, 20887, and 20888.

20842 ON THE RELATION OF ION AND ELECTRON EMISSION TO DIODE DIAGNOSTICS. Roland Breitwieser (Lewis Research Center, Cleveland). p.17-26 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The detailed understanding of the mechanisms governing the performance of a thermionic converter is confused by the interactions between the electrodes and the plasma in the interelectrode space. A guard-ring variable-spacing diode capable of spacings as small as 8μ was used to minimize the electron and the ion transport effects in the plasma. Relations were established that satisfactorily interrelate electron and ion emissions of an oriented tungsten emitter over a broad range of emitter temperatures and cesium pressures. An electron work function determined from saturation currents and the use of the Richardson Dushman emission equation is in general agreement with empirical extrapolations of the early Langmuir-Taylor low-pressure cesium experiments. Work functions based on observed ion currents were determined by the use of the Langmuir-Saha equation. A field effect was noted and was adequately treated by the application of the Schottky mirror-image theory. The work functions determined from ion currents are generally 0.07 ev higher than those obtained by electron emission. The electron and the ion-emission properties yield information on the surface potentials existing in the plasma. This information coupled with an energy balance of the converter indicates that the anomalously high currents observed during the ignited mode of operation can be described in terms of a large ion current from the plasma space that in turn pumps atoms to the emitter surface. The ion-atom charge-exchange process is the assumed mechanism that alters the particle arrival rates. The upper limit of the particle arrival rates is postulated to be about two times the normal atom arrival rate except in the case of very high ion currents. (auth)

20843 THEORETICAL CURRENT-VOLTAGE CURVE IN LOW-PRESSURE CESIUM DIODE FOR ION-RICH EMISSION. C. M. Goldstein (Lewis Research Center, Cleveland). p.27-32 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Current-voltage characteristics for the two-species collisionless infinite parallel-plate thermionic diode were

computed for ion-rich emission. It is shown that over a wide range of α (ratio of ion- to electron-emission charge density) the two-species total ion-current characteristic differs appreciably from the single-species characteristic based on Langmuir's solutions. In addition, it is shown that the net-current characteristic is even more liable to misinterpretation due to the nonnegligible electron current, even for large α. (auth)

20844 VOLTAGE-CURRENT DATA INTERPRETED IN RELATION TO ISOTHERMAL DIODE THEORY. W. B. Nottingham (Massachusetts Inst. of Tech., Cambridge). p.33-40 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

An analysis of voltage-current curves taken on many diode configurations indicates that for spacing equal to or greater than the electron mean-free path effects of both electron and ion space charge are often present. To aid in the interpretation of these maxima and minima in the interelectrode motive function, a brief review of the analysis of the isothermal diode is presented. This analysis is then related to the current-voltage curves observed in the spacing range from 10 to 800 μ with an emitter temperature of 1500°K and a cesium temperature of 500°K. The emitter sheath is electron-rich. (auth)

20845 ION DRAG OF ELECTRONS TO PRODUCE VERY HIGH OPEN-CIRCUIT VOLTAGES. W. B. Nottingham (Massachusetts Inst. of Tech., Cambridge). p.41-3 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A mechanism for supplying energy to electrons to produce very high open-circuit voltages in thermionic diodes is proposed. Ions, which are in a potential field created both by surface and space charges which would tend to accelerate the ions, deliver an appreciable amount of this energy to electrons. (C.E.S.)

20846 THE ELECTRON RICH, UNIGNITED MODE OF THERMIONIC DIODES. L. K. Hansen and C. Warner (Atomics International, Canoga Park, Calif.). p.44-50 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Backscattering or diffusion in thermionic diodes is examined in the electron-rich, unignited mode. Experiment and theory indicate an apparent saturation current with an inverse spacing dependence due to backscattering. Good agreement between experimental and theoretical volt-ampere characteristics is obtained. Values, for electrode work functions and electron and ion mean free paths, needed for the agreement, are examined. (auth)

20847 THE ION-RICH, UNIGNITED MODE OF THERMIONIC CONVERTERS. C. Warner (Atomics International, Canoga Park, Calif.). p.51-6 of "Report of the Thermionic Conversion Specialists Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A theoretical model is developed for the ion-rich, unignited mode under the assumption that the injected electrons are accelerated by the plasma electric field and scattered uniformly in direction by infinitely heavy cesium atoms. The strong spacing dependence of the saturation current is calculated for three values (10, 100, 1000) of the ratio β of emitted ion density to emitted electron density. These results demonstrate the importance of backscattering or diffusion in the ion-rich, unignited mode. (auth)

20848 THEORETICAL MODEL OF A THERMIONIC CONVERTER. James D. Dunlop (General Motors Corp., Indianapolis) and George L. Schrenk (Univ. of Pennsylvania, Philadelphia). p.57-62 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A generalized theoretical model of a thermionic converter operating in a cesiated atmosphere is presented. This model applies to the wide spaced diode where the spacing is many times the mean free path—i.e., to the case where a plasma characterized by its own variables is formed in the interelectrode spacing. A phenomenological macroscopic approach is used in the formulation of this steady state model. This approach includes the effects of volume ionization and recombination, plasma resistivity, and surface ionization. A set of 13 equations were formulated to describe this model. These equations were successfully solved on an IBM 7094 computer. The voltage-current characteristics predicted agree favorably with experimental data in the passive mode of operation and in the prediction of the point where the arc mode starts. The efficiency was optimized as a function of emitter temperature, effective work function, and lead resistance similar to the work done by Schock. Additional parameters for optimum efficiency in this model are cesium temperature and spacing. The results reported for this model should give a more realistic approximation to the maximum efficiency obtainable from a wide spaced plasma diode. (auth)

20849 INTERPRETATION OF CURRENT VOLTAGE CHARACTERISTICS OF CESIUM CONVERTERS IN THE IGNITED MODE OF OPERATION. E. N. Carabateas and A. Kniazzeh (Massachusetts Inst. of Tech., Cambridge). p.63-71 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

An analysis of the ignited mode of operation of cesium converters is carried out assuming that the electrons excite atoms to the first excited state and subsequently molecular ions are formed by collisions between two excited atoms. From the energy balance for the electrons an analytic expression for the current-voltage characteristic is derived. A quantity F which can be computed directly from an experimental current-voltage characteristic is defined such that for ideal operation F should be constant over the entire curve. In the ignited mode F changes with output current density and a measure of the departures from ideality can be obtained from a plot of F versus $j^{-\frac{1}{2}}$ according to the results of the analysis. Experimental current-voltage characteristics in the ignited mode are shown in plots of F versus $j^{-\frac{1}{2}}$ which are linear up to current densities of the order of 7 amps/cm^2 with slopes independent of pressure in agreement with the analysis. From the intercepts of the extrapolated straight lines with the F-axis an estimate of the collector work function can be made from data in the ignited mode of operation. (auth)

20850 VOLUME IONIZATION PROCESSES IN CESIUM CONVERTERS. Harald L. Witting and Elias P. Gyftopoulos (Massachusetts Inst. of Tech., Cambridge). p.72-80 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The mechanisms leading to ion formation in the plasma of a low emitter temperature cesium converter, operating in the ignited mode, are investigated. It is found that most of the ions are molecular and that they are formed by col-

lisions between excited atoms. Excited atoms are produced by inelastic electron collisions. Excitation and de-excitation cross sections are calculated by means of the impact parameter method and the principle of detailed balance, respectively. The effect of resonance radiation trapping is treated in detail by computing the photon escape probability as a function of frequency. Radiation and diffusion losses are found to be small except close to the boundaries. The ionization rate is determined from the recombination rate for molecular ions by means of statistical thermodynamics. The plasma concentration is determined as a function of the electron temperature. Performance characteristics of converters operating in the ignited mode are derived, without adjustable constants. Good agreement between theory and available experimental results is established. (auth)

20851 EXPERIMENTS ON THE LOW VOLTAGE ARC. W. Bloss and W. Krezdorn (Institut fuer Gasentladungstechnik und Photoelektronik, Stuttgart). p.81-6 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

In cylindrical thermionic diodes with BaO emitter and Ta collector the low voltage arc mode ($U_B \approx 3$ V) was investigated. A weak axial magnetic field (100 G) was applied which causes a uniform rotation of the plasma ball. This rotation permits single and double probe measurements of the plasma parameters. The ionization mechanism, including cumulative ionization is discussed. (auth)

20852 ENERGY-TRANSFER MEASUREMENTS AND CORRELATIONS ON A CESIUM THERMIONIC CONVERTER. J. W. Holland (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.87-93 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Measurements of energy transfer and performance were obtained on a highly instrumented cylindrical cesium thermionic converter with an electrically heated emitter of vapor-deposited tungsten and a molybdenum collector. Values of the emitter electron cooling, collector electron heating, thermal radiation, cesium conduction, and the emitter stem electrical losses were calorimetrically or electrically determined as a function of emitter temperature, collector temperature, cesium pressure, and current. For all the data obtained, the emitter temperature profile was measured by thermocouples. A correlation was found to predict emitter electron cooling energy from current-voltage data. As a result, complete converter energy balances may be predicted with a two-dimensional digital computer energy transfer code, the materials properties, and the electron cooling correlation. (auth)

20853 RESONANCE ABSORPTION AND IONIZATION PROCESSES IN CESIUM VAPOR. D. H. Pollock, A. O. Jensen, and J. A. Duardo (Electro-Optical Systems, Inc., Pasadena, Calif.). p.94-102 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The results of absolute absorption measurements in cesium vapor near the atomic resonance lines at 8521 and 8943 Å and the molecular band at 7600 Å are reported for cesium vapor pressure ranges of interest to high-power density cesium vapor thermionic converters. On the basis of the present work and that of Mohler and Freudenberg, an ionization mechanism was hypothesized for the production of Cs_2^+ as the dominant ionic specie in high pressure cesium vapor thermionic converter plasmas. The mechanism consists of cesium atoms first being excited to approximately the 1.45-ev level by resonance radiation emitted from a hot thermionic emitter and subsequently colliding with other excited atoms to form the molecular cesium ion. Ionization measurements are reported which indicate a strong influence of resonance radiation on ion generation in moderately high pressure cesium vapor plasmas. (auth)

20854 RESULTS FROM A SPECTROSCOPIC INVESTIGATION OF A THERMIONIC CONVERTER. J. D. Dunlop, R. T. Schneider, and W. Woerner. p.113-20 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The plasma properties of an energy converter operating in the power generation region were investigated. Spectra were obtained for the converter operating in four different modes—passive mode (space charge limited), oscillating region, ignited mode, and arc mode. In the passive mode only the cesium resonance lines were observed. In the oscillating region cesium lines corresponding to higher energy states were observed. Thus, either the energy of the electrons was increased or the number of collisions with high energy electrons was increased due to the oscillations. In the arc mode the radiation intensity was much higher than for other modes of operation. Using different cesium lines the ion and electron density was estimated by line broadening measurements. The electron temperature in the arc mode was determined by measurements of intensity ratios of lines originating from transitions between high energy levels. The temperature so determined was within an error limit of ±20%. Thus, in the arc mode the deviation from a Boltzmann distribution is not large enough, at least for the higher energy levels, to yield different temperatures for different line pairs within the error of measurement. (auth)

20855 OPERATION AND ANALYSIS OF A PARALLEL PLANE CESIUM THERMIONIC CONVERTER WITH AN OXYGEN-TREATED TANTALUM EMITTER. V. C. Wilson and J. Lawrence (General Electric Co., Schenectady, N. Y.). p.121-8 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

An oxygen treated tantalum emitter was prepared and operated in a parallel plane cesium converter in the high pressure mode. The current voltage curves are very similar to those from a converter having a clean tantalum emitter when taken under similar conditions except for cesium pressure. The tube with the oxygen treated tantalum emitter operates at half the cesium pressure necessary for the tube with the clean tantalum emitter. This suggests that the oxygen treated tantalum surface adsorbs cesium more strongly than does the clean tantalum surface. From this comparison, it appears that in the high pressure thermionic converter the neutral cesium atom density has little effect on the discharge characteristics. Most of the electron scattering is by ions rather than atoms. One concludes that the positive ion concentration is not limited by the available number of neutral cesium atoms, but rather depends upon the ionization mechanisms and the energy available to generate ions. (auth)

20856 GAS ANALYSIS AND GAS DOSING OF CESIUM VAPOR DIODES. J. R. Fendley, Jr. (RCA Labs., Princeton, N. J.). p.129-33 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Apparatus for analysis of the outgassing from an operating cesium diode and for the introduction of known gases

was constructed to determine the effects of impurity gases on cesium diodes. It was found that arc mode cesium diodes have a remarkable tolerance for xenon. (C.E.S.)

20857 ANALYSIS OF CAPILLARY CONVERTER EXPERIMENTAL RESULTS. D. L. Dresser (General Motors Corp., Indianapolis). p.134-43 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Recent experimental results from a laboratory type capillary converter are described. These include general current-voltage characteristics in the power producing region as a function of emitter temperature (1400-2100°K), cesium temperature (473-573°K), and electrode spacing (0.3-2.0 mm) and reverse current measurements as a function of collector temperature. The electron and ion currents are compared to a random current theoretical model. Contact potential measurements are used to evaluate the work function of the emitter. The reverse current appears to consist of back electron emission from the collector and ions generated within the capillary cavities. Maximum power densities of 5 to 15 watts/cm^2 at 2000 and 2100°K are reported in the passive mode. Two features of this data are of interest for a practical device based upon the capillary emitter concept. These are comparatively wide electrode spacing (0.3 to 1.0 mm) and high converter voltage (1.25 to 1.5 volts). (auth)

20858 AUXILIARY DISCHARGE THERMIONIC ENERGY CONVERTER. Marvin Fox and R. C. Knechtli (Hughes Research Labs, Malibu, Calif.). p.144-8 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The experimental and theoretical performance of an auxiliary discharge thermionic energy converter are discussed. The discharge provides an auxiliary electron emitter and reduces the effective electrode area. (C.E.S.)

20859 RECENT ADVANCES IN LOW TEMPERATURE THERMIONICS. Lewis L. Haring (Ford Instrument Co., Long Island City, N. Y.). p.149-53 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A planar diode life test has successfully operated with 2 watt/cm^2 performance at temperatures under 1200°C for a period over 8,000 hours. The mechanism of performance slump and its reversal in this converter type was explored and explained as a collector phenomenon. Prototype cylindrical converters of reasonable size (9 cm^2) produced power densities of the order of 2 watts/cm^2 with actual efficiencies of 6% at temperatures under 1300°C. (auth)

20860 NOBLE GAS IONIZATION BY FISSION FRAGMENTS. C. B. Leffert, F. E. Jamerson, and D. B. Rees (General Motors Research Labs., Warren, Mich.). p.154-63 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Recent inpile studies on the fission fragment ionization of noble gases are presented. The effect of gas pressure on ion source rate was studied with two types of ion chamber tubes. In both tubes uranium foil was bonded to the inside surface of planar metal electrodes to provide the fission fragments. A thin uranium foil was used to minimize heat generation and suppress thermionic emission of electrons. The planar electrodes of the first tubes were sealed inside a gas filled glass envelope and it was found that at low reactor power the interpretation of current-voltage data was complicated by the presence of a gamma induced plasma external to the interelectrode volume. In order to eliminate this effect and also measure the individual contribution to current of gamma and fission fragment ionization, a series of ceramic-metal tubes were constructed that had three planar electrodes forming a double diode. One diode was gamma sensitive only, whereas the other had a uranium foil on one electrode. These double diodes were operated in monoisopropylbiphenyl oil to eliminate the ion source external to the electrodes. It was found from these tubes that the current contribution resulting from gamma ionization was, in general, only ~ 1% of that resulting from ionization due to fission fragments. Ion source rates for various gas pressures of neon, argon, xenon, and, neon:argon (1000:1) were determined from the experimental current-voltage data using a plasma theory based on the assumption that the ion number density in the plasma between the two electrode sheaths was limited by volume recombination loss. The theory accurately described the shape of the current-voltage curves and the values of source rate determined by the application of the theory to the experimental curves are in good agreement with the values of source rate calculated independently from the ionization energy loss of fission fragments in the gas. (auth)

20861 IRRADIATED INERT GAS-FILLED THERMIONIC DIODES. Ralph Forman (Union Carbide Corp., Parma, Ohio). p.164-8 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The feasibility of the design of an inert gas-filled thermionic converter in which the space charge is neutralized by positive ions produced in the gas by radiation is investigated. Results of xenon- and krypton-filled diodes subjected to in-core irradiation are given. (C.E.S.)

20862 CORRELATIONS OF OBSERVED NON-UNIFORM EMISSION FROM SURFACES IN CESIUM VAPOR. N. S. Rasor, S. S. Kitrilakis, and D. P. Lieb (Thermo Electron Engineering Corp., Cambridge, Mass.). p.169-78 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

An approach is described by which the effect of surface non-uniformity on converter performance can be unambiguously assessed and diagnosed. New methods developed for the required display of emission from surfaces immersed in cesium vapor are described. Results are presented which show large differences in emission from various single crystal and polycrystalline samples mounted on the same emitter in cesium vapor. The dependence of the observed emission on cesium pressure and surface temperature is in general accord with theoretical expectations. The observed non-uniformity is concluded to be of substantial significance to converter performance. (auth)

20863 UNIFORM WORK FUNCTION EMITTER STUDIES. M. N. Huberman (Atomics International, Canoga Park, Calif.) and R. A. Holzl. p.179-86 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A materials study was made to obtain uniform work function emitters in order to eliminate effects associated with work function patches in thermionic converters. The approach was to obtain preferred orientation emitters using chemical vapor deposition of molybdenum. Three basic processes were employed: hydrogen reduction of molybdenum hexafluoride, pyrolysis of molybdenum penta-

chloride, and pyrolysis of molybdenum carbonyl. Deposition temperatures, rates, and thicknesses were varied for each process. X-ray analysis showed that (100) and (111) fiber orientations can be obtained with both fluoride reduction and chloride pyrolysis samples. Satisfactory depositions could not be obtained with the carbonyl process. An emission microscope was build to determine patch distributions on emitter surfaces. Work function variations on randomly oriented surfaces were observed. Multigrained uniform work function areas of millimeter dimensions were found on a polished vapor deposited emitter having a (111) preferred orientation. (auth)

20864 WORK FUNCTION OF THE 110 PLANE OF TANTALUM AS A FUNCTION OF CESIUM COVERAGE. H. F. Webster (General Electric Research Lab., Schenectady, N. Y.). p.187-191 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The change of work function of two tantalum crystals was measured as cesium deposits on their surfaces by a method first used by Shelton. The measurements are made by determining the contact potential difference between a reference crystal which serves as a pure metal emitter and the collector crystal which has its work function changed by the added cesium layer. The results obtained are in qualitative agreement with the theory of Rasor and Warner, but the change of work function measured in three runs was about 0.2 volts larger than predicted by the theory. (auth)

20865 A DETAILED INVESTIGATION OF MOLYBDENUM AS AN ELECTRODE MATERIAL FOR CESIUM VAPOR THERMIONIC CONVERTERS. A. O. Jensen, A. E. Campbell, W. D. Dong (Electro-Optical Systems, Inc., Pasadena, Calif.). p.192-201 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The results of a detailed investigation on two types of recrystallized polycrystalline molybdenum as an electrode material for cesium vapor thermionic converters are reported. Arc cast molybdenum bar stock and plate stock were examined. Measurements of cesiated emission and effective work function of plate and bar stock molybdenum at temperature and cesium arrival rates appropriate to practical cesium vapor thermionic converter operating conditions are reported. Recrystallized molybdenum plate stock and bar stock emitters were examined in detail by metallographic means, x-ray-diffraction techniques, with a thermionic electron emission microscope, and by electron emission measurements on the cesiated material. (auth)

20866 A DIMENSIONLESS PARAMETER CHARACTERIZING ELECTRON EMISSION S-CURVES. Jules D. Levine (RCA Labs., Princeton, N. J.). p.202-5 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A simple approximate analysis of S-curves for different absorbates, substrates, and arrival rates is presented. The range of interest is the rising part $0.1 < \Theta < 0.4$ of the S-curves where the equation of state is simple and where many cesium-coated thermionic emitters operate. A previously unrecognized dimensionless parameter that seems to control the relative performance of S-curves is postulated. (C.E.S.)

20867 EXPERIMENTAL EVALUATION OF THE EFFECTIVE EMITTER WORK FUNCTION IN ARC MODE THERMIONIC CONVERTERS. F. Harter, J. G. Darrah, and P. Bolan (United Aircraft Corp., Hartford, Conn.). p.206-13 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A simple method of measuring the emitter work function in a cesium thermionic converter operating in arc mode was devised and is being developed. This method is based on measurement of the thermal energy required by the emitter for electron emission; often called electron cooling. Tantalum and tungsten–rhenium alloy emitter work functions were determined over an emitter temperature range from 1275 to 1890°K. The tantalum data compare favorably with published values. Lack of published data prevented a comparison of the tungsten–rhenium alloy emitter work function. (auth)

20868 MEASUREMENT OF EMITTER HEAT BALANCE IN A CESIUM THERMIONIC CONVERTER. J. M. Houston (General Electric Research Lab., Schenectady, N. Y.). p.214-23 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Measurements were made on a cylindrical, indirectly heated Cs-vapor thermionic converter having a stainless-steel collector spaced 1 mm from a 13.3 cm^2 Th–W emitter. At an emitter temperature of 2200°K a power output of 8.8 watt/cm^2 (at 1.2 volt) at a measured overall efficiency of 11.9% was observed. Measurements of the cooling of the emitter due to electron emission indicate that in the retarding range of the converter the emission cooling is just what simple theory would predict, the electron temperature in the plasma being equal to the emitter temperature. However, for collector-to-emitter voltages more positive than approximately −1.3 volt, the emission cooling fell far below that predicted by simple electron emission from the emitter, indicating that large amounts of power (as much as 20 watt/cm^2 at positive collector voltages) was flowing from the plasma back to the emitter. This anomaly in emission cooling is due to Cs excited atoms, ions, and resonance radiation returning to the emitter. These originate in a region of high electron temperature adjacent to the emitter. (auth)

20869 APPARENT DEPENDENCE OF COLLECTOR WORK FUNCTION ON EMITTER TEMPERATURE. John M. Houston (General Electric Research Lab., Schenectady, N. Y.). p.224-7 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Measurements that apparently indicate that the collector work function depends somewhat on the emitter temperature are presented. (C.E.S.)

20870 CESIUM-COATED OXIDE FILM COLLECTORS FOR THERMIONIC CONVERTERS. R. A. Chapman and H. W. Hemstreet, Jr. CESIUM COMPOUND SEMICONDUCTOR FILM COLLECTORS FOR THERMIONIC CONVERTERS. H. J. Caulfield, R. A. Chapman, and H. W. Hemstreet, Jr. p.228-35 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

These studies yielded stable thermionic work functions near 1.4 ev. Aluminum oxide and nickel oxide films on substrates of the parent metal were studied as collectors in cesium vapor. The nickel oxide undergoes an initial, unstable extremely low work function stage after which both oxide coated electrodes have work functions near 1.4 ev. Several cesium semiconductors which were previously reported yield similar work functions. The methods of measurement are discussed in some detail and a collector

comparator device is described which will operate at high cesium pressures. Initial test runs on the comparator are presented. (auth)

20871 STUDY OF THE INFLUENCE OF ADDITIVES ON WORK FUNCTION AND POWER OUTPUT OF THERMIONIC CELLS. B. S. Rump, J. F. Bryant, and B. L. Gehman (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.236-9 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The influence of hydrogen on the work function and power output of a filamentary cell using a tungsten emitter and a nickel collector in cesium vapor was investigated. It is shown that a surface covered with cesium hydride definitely exhibits a lower work function than the cesium-covered surface. Power enhancement by hydrogen addition is also obtained. (C.E.S.)

20872 EVALUATION OF "SINGLE" CRYSTAL MOLYBDENUM AS AN EMITTER MATERIAL. Howard Steele and Katsunori Shimada (Boeing Co., Seattle). p.240-6 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Vacuum measurements on a high perfection molybdenum crystal are reported. X-ray techniques demonstrated that the 110 planes were within one degree of the surface being studied. The surface preparation techniques and electron microscope pictures of the resulting surface were presented previously. In order to accurately measure the work function of the surface it was necessary to fabricate a high-vacuum, high-temperature parallel plane diode with a collector guard ring flush with the collector and within 0.01 centimeters of the collector. Leakage current between collector and guard made it necessary to develop a circuit to dynamically maintain the guard at the collector voltage. The leakage current from emitter to collector was cancelled in the viewing resistor by a nulling scheme. A comparison of measured volt-ampere curves with Langmuir space charge theory indicates that the Richardson current can be accurately identified. A Richardson plot indicates a work function of 4.90 ± .05 volts with the Richardson constant set at 1.2×10^6 amperes per square meter per degree Kelvin squared for temperatures between 1700 and 2200 degrees Kelvin. This is in good agreement with measurements on the 110 plane of a single crystal wire. Data on the enhanced emission in the asymptotic Schottky or accelerating potential region indicate that the sub-microscopic roughness is less pronounced than in single crystal wire experiments. (auth)

20873 CESIUM COMPATIBILITY OF THERMIONIC CONVERTER STRUCTURAL MATERIALS. W. B. Hall and S. W. Kessler (Radio Corp. of America, Lancaster, Penna.). p.247-56 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Ceramic materials, metals, and alloys were exposed to cesium at 750°C and 10 torrs. The corrosion results are presented. (C.E.S.)

20874 COMPATIBILITY OF URANIUM-BEARING NUCLEAR FUELS AND REFRACTORY-METAL THERMIONIC EMITTERS. M. H. Horner, A. F. Weinberg, and L. Yang (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.257-65 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963. (GA-4698)

Previously reported studies of the compatibility of UC, UZrC, and UO_2 with tungsten, molybdenum, tantalum, and niobium were extended to include rhenium, iridium, and the tungsten-base alloys W-2.6 wt % Re, W-15 wt % Mo, and W-2 wt % Mo. The temperature of prime interest was 1800°C, but the studies included temperatures as low as 1200°C. In addition to short-term testing of conventional diffusion couples, tests were conducted for times up to 1100 hr, using both conventional techniques and the monitoring of vacuum electron emission from a clad fuel pellet as a means of detecting diffusing fuel components. (auth)

20875 EFFECTS OF CARBON ON THE THERMIONIC EMISSION BEHAVIOR OF TUNGSTEN. J. B. Baker and G. B. Gaines (Battelle Memorial Inst., Columbus, Ohio). p.266-74 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Often the thermal electron emission properties of an emitting surface undergo substantial changes when the surface is contaminated by very low concentrations of impurities. This behavior is being used to develop sensitive methods for investigating high temperature compatibility problems in systems where some type of reaction releases a material which can diffuse to the surface. The thermal electron emission behavior of tungsten–carbon was determined in greater detail than in previous investigations. For this system two emission states were detected. One of these shows emission of a much higher level than that of pure tungsten and appears to occur when the emitting surface is composed of WC. For the second state the emission level is slightly lower than the level for pure tungsten. This state occurs when the emitting surface is composed of W_2C. (auth)

20876 COMPATIBILITY OF NUCLEAR FUEL AND THERMIONIC EMITTER MATERIALS. M. J. Sanderson, L. N. Grossman, H. W. Hill, and A. I. Kaznoff (General Electric Co., Pleasanton, Calif.). p.275-8 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Post-test metallographic and electron microprobe analyses were completed on $UO_{2.005}$–W and $UO_{2.005}$–Mo fuel-emitter specimens exposed to temperatures of 1700, 1800, 1900, and 2000°C. The results indicate that no significant interaction of these materials occurred at the fuel-emitter interface during the test condition. Hyperstoichiometric UO_2 tested in contact with molybdenum shows evidence of liquid phase formation at equivalent temperatures. Observations of grain growth and creep of the refractory metals, and densification of the UO_2 are noted. (auth)

20877 THE DEVELOPMENT OF BARIUM–URANIUM EMITTER MATERIALS. Robert F. Hill and Fay E. Gifford (General Motors Research Labs., Warren, Mich.). p.279-86 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

This program was directed toward the fabrication, operation, and testing of unclad nuclear heated thermionic emitters that can be operated in the 1100–1300°C temperature range with an expected current density of 1–10 amps/cm^2. Various nuclear fuels impregnated with an activating agent were evaluated both from the standpoint of physical and chemical properties as well as electron emission characteristics. Materials containing various concentrations of BaO in UO_2 were combined with tungsten and fabricated into dense compacts. The metallurgical examinations in-

dicated that BaO and UO_2 form several compounds of which $BaUO_3$ and Ba_2UO_4 were identified. The evaporation rate studies and thermionic emission studies indicated that the $BaO-UO_2-W$ emitter materials are comparable to the $BaO-Al_2O_3-W$ materials that are employed in many impregnated emitters. At 1200°C, electron current densities in the vicinity of 10 amps/cm^2 were obtained with evaporation rates of 1×10^{-5} gm/cm^2-hr as measured by a weight loss method. The surfaces of the $BaO-UO_2-W$ emitters were also studied on the thermionic emission microscope. (auth)

20878 CONVERTER PERFORMANCE TEST OF A RHENIUM EMITTER IN CONTACT WITH A CARBIDE FUEL. R. C. Howard, (Thermo Electron Engineering Corp., Cambridge, Mass.), D. L. Keller, and C. K. Smith. p.287-94 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The compatibility of rhenium with uranium carbide fuel materials is investigated. The effect on electron emission of uranium and carbon diffusion to the rhenium surface, the effect of carbon absorption on the physical properties of uranium, and the loss of carbon from the surface of rhenium due to interaction with cesium are studied. (C.E.S.)

20879 RECENT PROGRESS IN THE DEVELOPMENT OF SOLAR THERMIONIC CONVERTERS. S. G. Merra and J. H. Weinstein (Thermo Electron Engineering Corp., Cambridge, Mass.). p.295-304 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Results obtained during electrical testing of solar thermionic converters under both steady state and cyclical conditions are reported. Converters were operated both singly and in series connections. Static and dynamic I–V curves are shown, and steady state and cycling life test data are presented. (auth)

20880 RESULTS OF LABORATORY TESTS OF SET THERMIONIC CONVERTERS AND GENERATORS. Peter Rouklove (California Inst. of Tech., Pasadena). p.305-13 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Development of Solar Energy Thermionic (SET) Converters and Generators is discussed. Employing multiconverter generators, the system SET I second generation of design evolution, has provided an observed maximum output of 82.4 watts at a measured efficiency of 7.5%. Typical current thermionic designs and their evaluation are presented. Although some problem areas still exist, present status indicates that a degree of optimism is justified for future SET power applications. (auth)

20881 THE DESIGN, DEVELOPMENT, AND IN-PILE TESTING OF A NUCLEAR-FUELED THERMIONIC ENERGY CONVERTER. F. G. Block, G. Y. Eastman, and W. E. Harbaugh (Radio Corp. of America, Lancaster, Penna.). p.323-31 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A cesium diode thermionic converter, designed especially for thermionic reactor applications, was built and electrically tested to full power output for long periods of time. The practicability of the design was confirmed by converter operation in the core of a reactor for better than 300 hours during which period it produced more than 38 kilowatt-hours of electricity. (auth)

20882 TEST RESULTS ON AN IN-PILE NUCLEAR THERMIONIC CONVERTER. Eric S. Beckjord (General Electric Co., Pleasanton, Calif.). p.332-40 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

An in-pile nuclear thermionic converter was tested for 224 hours. The peak power output was 6.2 watts per square centimeter at an efficiency of about 10.5%. The emitter temperature was calculated to be about 1800°C at this point. The emitter was made of tungsten fueled with enriched uranium dioxide, and spaced at 10 mils from the Inconel collector. Post-irradiation examination disclosed the cause of failure of the converter to be a leak in the copper pinch-off tube, which permitted the external heat transfer gas to enter the converter and the cesium to escape. Structurally the converter was otherwise unchanged by operation. (auth)

20883 SERIES OPERATION OF THERMIONIC DIODES IN A NUCLEAR FUEL ELEMENT CONFIGURATION. James D. Long, Hugh L. Garvin, and Richard L. Hobbs (Martin Co., Baltimore). p.341-4 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

The series operation of thermionic energy converters in a common cesium reservoir was demonstrated in a laboratory simulation of a nuclear fuel element configuration. The test modules operated in this program contained two cylindrical emitters arranged end-to-end with an intermodular lead and ceramic spacers provided to permit the series addition of the thermionic output. Although electron bombardment was used to simulate fission heating of the 15 cm^2 emitters, uranium-bearing cermet fuel was contained as an integral part of the emitters for compatibility tests of the fuel-emitter interface and for subsequent application to nuclear irradiation tests. The electrical output characteristics indicate that the series output of the diodes results in a voltage addition of their separate output characteristics. The effects of back emission and arcing in the intermodular space were found to be minimized by the design chosen. The double modules were tested for over 700 hours with emitter temperatures in the range of 1500 to 1800°C. (auth)

20884 ANALYSIS OF MULTICELL NETWORKS. J. H. Broido, C. W. Savery, and W. B. Wright (General Atomic Div., General Dynamics Corp., San Diego, Calif.). p.345-7 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A digital-computer code which describes the performance of thermionic diodes is described. Detailed data derived from physics research on operating thermionic diodes are incorporated in the library of this code. Semiquantitative estimates can be made of the thermionic performance of single diodes and of networks of these diodes in a reactor environment. (C.E.S.)

20885 THERMIONIC CONVERTER OPERATION IN MULTIPLE CONNECTION. G. Y. Eastman, A. Basiulis, and W. E. Harbaugh (Radio Corp. of America, Lancaster, Penna.). p.348-55 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Performance data for nuclear-fueled thermionic cells are presented that can be used to predict the operation of converters in series or parallel connection. (C.E.S.)

20886 INTERNAL FLAME-HEATED THERMIONIC CONVERTERS. W. R. Martini (Atomics International, Canoga Park, Calif.). p. 356-61 of "Report of the Therm-

ionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Internally heated converters were chosen because they have less heat loss and a lighter system weight than comparable externally heated converters. A burner assembly was developed for a 1 in. diameter emitter with a measured 35% heating efficiency at 35 w/cm^2 heat flux and at 1400°C emitter temperature. An emitter hot shell using the system, vacuum–Mo–$MoSi_2$–SiC–flame was tested at 1300–1400°C for 650 hours. The same hot shell formulation exhibited a gas permeation rate of 0.003 cm^3(stp)/hr. The utility of the internally heated converter is illustrated with a portable power source design using a single thermionic converter coupled with an electrical converter to give 50 watts output from a 10 pound package. (auth)

20887 DEVELOPMENT OF A LIGHTWEIGHT GASOLINE FUELED THERMIONIC ENGINE. F. J. Lyczko and H. L. Traiger (Thermo Electron Engineering Corp., Cambridge, Mass.). p.362-71 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

Recent progress toward a rugged, lightweight, and silent 45-watt gasoline-fired thermionic power system is reviewed. The key parts of the system are the thermionic diodes, the high-temperature burner, and the diode vacuum enclosure. Test data are presented showing the latest performance of each of these components. The progress of the system design is also included in this discussion. (auth)

20888 ASYMMETRICAL AC THERMIONICS. Walter R. Oppen (Ford Instrument Co., Long Island City, N. Y.). p.372-5 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963.

A system in which a single thermionic cell is made to deliver power at useful voltage levels, typically 28 volts, from a cell that, under normal operating conditions, would deliver only 0.3 volts into a matched load is described. This is accomplished by switching the cell on and off so that it delivers a pulsating d-c to the load through a transformer. Cell switching operations are conducted in the relatively high voltage secondary components with semiconductor components. (C.E.S.)

20889 IMPROVEMENTS RELATING TO MAGNETOHYDRODYNAMIC GENERATORS USING A NUCLEAR REACTION TO HEAT THE WORKING FLUID. (to United Aircraft Corp.). British Patent 954,928. Apr. 8, 1964. Priority date Sept. 12, 1960, United States.

A magnetohydrodynamic generator using a nuclear material in the working fluid which is passed through a magnetic field during fission, is designed for the production of a-c power. The generator is similar to that described in British Patent 928,836, except that a-c is produced by cyclically varying the fission rate or the magnetic field. Several ways of obtaining the cyclic variation to produce any form of a-c wave patterns are described. (D. L.C.)

20890 MAGNETOHYDRODYNAMIC GENERATOR. Alfred Kaech (to Aktiengesellschaft Brown, Boveri & Cie). U. S. Patent 3,130,330. Apr. 21, 1964. Priority date Aug. 8, 1959, Switzerland.

A magnetohydrodynamic generator is designed for producing an alternating current. The generator utilizes a magnetic field which changes its direction at a frequency but which has a constant field strength; this magnetic field is established by a stator with at least three pole heads, each carrying a magnetizing winding. Thus, the production of pressure waves by a pulsating magnetic field is avoided. (D.L.C.)

Elementary Particles and Radiations

Refer also to abstract 21024.

20891 (AD-433625) INTERACTIONS OF 17 Gev/c NEGATIVE PIONS. Technical Report UCB-64-1. F. R. Huson and W. B. Fretter (California. Univ., Berkeley). Feb. 3, 1964. 55p.

The interactions were studied in a liquid freon-propane bubble chamber. The mesons (π^0) were reconstructed from the electron pairs arising from the π^0 decay gamma rays. The mesons (π^0), as expected, had the same transverse momentum distribution as the charged pions. The π^--N interactions were analyzed by a two-vertex model in which all particles going forward in the π-N center of mass were attributed to the pion vertex and those going backward were assumed to come from the nucleon vertex. The predominant resonance was the Δ_δ ($^3/_2$, $^3/_2$, 1238), which was produced at the nucleon vertex in about 50% of all inelastic π-N interactions. The most interesting observation was that of Coulomb and diffraction dissociation. The cross sections obtained were about 6 mb for Coulomb dissociation of a pion into a meson (ρ) on Br and about 9 mb for diffraction dissociation into 3 or 5 pions on C and F. The diffraction dissociation events with three final pions had the largest individual channel cross section (8 mb). In these events, the meson (ρ) was produced in about 75% of the interactions. The three-pion mass distribution was concentrated between 900 and 1500 Mev. (D.C.W.)

20892 (AD-434059) THE CONVERGENCE OF A RANDOM DISTRIBUTION FUNCTION ASSOCIATED WITH A BRANCHING PROCESS. Technical Report No. 96. P. E. Ney (Stanford Univ., Calif.). Mar. 12, 1964. Contract Nonr-225(52) (NR-342-022). 28p.

The diffusion of particles throughout d-dimensional Euclidian space (Ω) is studied. A is taken to be a subset of Ω; and $N_t(A)$ is the number of particles in A at time t, while $M_t(A) = N_t(A)/N_t$ is the proportion of particles in A at t. It is shown that the branching character of the process alone implies detailed results about its asymptotic behavior without requiring any specific distribution assumptions. Processes of the form $M_t(A_t)$, where the sets A_t vary with t, are then considered. It is shown that by letting A_t grow in a suitable manner, convergence (in mean square) of $M_t(A_t)$ to a Gaussian probability function can be obtained. (auth)

20893 (AFOSR-5287) THEORETICAL STUDY OF PARTICLE POLARIZATION IN HIGH-ENERGY PHYSICS. Louis Michel (Paris. Universite, Orsay). [nd]. Contract AF61(052)-474. 33p. (AD-417148)

Covariant description of particle polarization is explained from the foundation of quantum theory and relativistic invariance. Several applications in high-energy physics are presented. (auth)

20894 (BNL-7969) DIPION MASS SPECTRA IN ANTIPROTON-PROTON ANNIHILATIONS AT 3-4 Bev/c. T. Ferbel, J. Sandweiss, H. D. Taft (Yale Univ., New Haven); M. Gailloud, T. W. Morris, W. J. Willis (Brookhaven National Lab., Upton, N. Y.); A. Bachman, P. Baumel, and R. M. Lea (City Coll., New York). [1964]. Contract AT-30-2-GEN-16. 11p.

Evidence for resonance behavior in the π^+-π^- mass spectrum at ~560 Mev was previously observed in an experiment in which all available final states of p-$\bar{p}$ annihilations were considered. The results of a control experiment in which only the π^+-π^- mass distribution was studied indicate that the previously observed effect was a statistical fluctuation. It was concluded that there was no evidence for a π^+-π^- interaction at 560 Mev. (D.C.W.)

20895 (CERN-64-6) PROCEEDINGS [OF] 1963 EASTER SCHOOL FOR PHYSICISTS USING THE NUCLEAR EMULSION TECHNIQUE IN CONJUNCTION WITH THE CERN PROTON SYNCHROTRON AND SYNCHRO-CYCLOTRON, ST. CERGUE, MARCH 20–27, 1963. D. Evans and W. O. Lock (European Organization for Nuclear Research, Geneva). Jan. 31, 1964. 223p.

Separate abstracts were prepared for six of the eight papers included. The other two papers, on hypernuclei and hyperon (Λ) interactions, were previously abstracted in NSA (see 17: 32900, 18: 15178). (D.C.W.)

For abstracts of individual papers see: 20896, 20897, 20898, 20899, 20900, and 20901.

20896 (CERN-64-6(p.1-30)) HIGH-ENERGY SCATTERING AND REGGE POLES. R. Hagedorn (European Organization for Nuclear Research, Geneva).

The experimental observation that the width of the diffraction peak in elastic p-p scattering decreases with increasing energy is analyzed in terms of Regge poles. (D.C.W.)

20897 (CERN-64-6(p.31-48)) EXPERIMENTAL TECHNIQUES FOR MEASURING ELASTIC SCATTERING AT VERY HIGH ENERGY. A. M. Wetherell (European Organization for Nuclear Research, Geneva).

The general features of the elastic scattering of strongly interacting particles at high energy are outlined; and bubble chamber, nuclear emulsion, spark chamber, and counter experiments are discussed. Future energies are briefly considered. (D.C.W.)

20898 (CERN-64-6(p.49-70)) THE CLASSIFICATION OF ELEMENTARY PARTICLES. L. Van Hove (European Organization for Nuclear Research, Geneva).

The classification of particles according to angular momentum on the basis of Regge poles is discussed, together with classification according to the octet symmetry. Principles, predictions, and agreement with observations are considered. (D.C.W.)

20899 (CERN-64-6(p.71-98)) EXPERIMENTAL OBSERVATIONS ON RESONANCES. G. Ekspong (Stockholm. Univ.).

The establishment of the existence of new particles and the determination of the properties of resonance particles are discussed. The techniques used are outlined, and the difficulties are indicated. Some results are considered. Also, some nuclear emulsion studies on the Y* (1405 Mev) are reviewed. (D.C.W.)

20900 (CERN-64-6(p.99-123)) NEUTRINO EXPERIMENTS. G. von Dardel (European Organization for Nuclear Research, Geneva).

Some of the properties of neutrino interactions that permit neutrino experiments with high-energy accelerators are summarized, and neutrino sources and detectors are discussed. The Brookhaven experiment that established the existence of two neutrinos is then reviewed, and a scheduled CERN experiment is described. (D.C.W.)

20901 (CERN-64-6(p.125-42)) SOME RESULTS AND PROBLEMS CONCERNING CURRENT DEVELOPMENT OF THE EMULSION METHOD. G. B. Zhdanov (Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva).

Some recent Soviet developments in the use of emulsions (in combination with ionization methods) to study nuclear interactions of cosmic rays ($>10^{11}$ ev) and to study interactions at $\lesssim$10 Bev using an accelerator are discussed. The equipment, difficulties, and techniques are described, together with a device for ionization and momentum measurements. Some results are also discussed. (D.C.W.)

20902 (JINR-E-1557) ON THE MEAN NUMBER OF π^0 MESONS PRODUCED IN INELASTIC π^--PROTON COLLISIONS AT 6-8 Gev/c. D. K. Kopylova, V. B. Lyubimov, and M. Spirchez (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 7p.

The mean number of mesons(π^0) produced in inelastic π^--p two prong interactions at 6.8 and 7.5 Gev/c was studied by electron pair conversion. A value of 0.6 ± 0.2 was obtained. The missing mass distribution for these events was peaked approximately at a value corresponding to 2 π^0. The low value of the total longitudinal momentum of secondary particles (4501 ± 446) Mev/c might be connected with the above mentioned results. It is very probable that a great contribution to these results is due to those collisions in which the momentum of the secondary meson(π^-) is greater than 1.5 Gev/c. (auth)

20903 (JINR-E-1581) ANOMALOUS SINGULARITIES AND DETERMINATION OF AMPLITUDES FOR SOME PROCESSES. B. N. Valuev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 17p.

The anomalous singularity conditions are shown to have a simple kinematical meaning in the case of unstable particles. If the total width tends to zero and some other conditions hold the anomalous singularity appears in the physical region. An experimental investigation of this singularity in reactions with resonance production may help to determine amplitudes of such processes as $\pi\pi \to \pi\pi$, $\pi\Lambda \to \pi\Lambda$, etc. Furthermore, anomalous singularity may manifest itself as humps in effective mass distributions thus imitating weak resonances. (For example, the hump in the effective mass distribution of K_1^0, K_1^0 pairs near 1 Bev and the so-called ABC-resonance, which perhaps indicates to the existence of excited nuclei, in which a nucleon is replaced by the isobar N* 1238). (auth)

20904 (JINR-P-1553) FAZOVYI ANALIZ NUKLON-NUKLONNOGO RASSEYANIYA PRI ENERGII 23.1 Mev. (A Phase Shift Analysis of Nucleon-Nucleon Scattering at 23.1 Mev). Yu. M. Kazarinov, V. S. Kiselev, and V. I. Satarov (Joint Inst. for Nuclear Research, Duban, U.S.S.R. Lab. of Nuclear Problems). 1964. 9p.

A phase shift analysis of n-p and p-p data at 23.1 Mev was performed. It was found that the number of solutions with a positive $^1S_0$ which give a good description of the experimental data does not exceed three. In all the sets phase shifts obtained, the mixing parameter and the phase shift of the $^3D_1$-wave were determined quite inadequately. (auth)

20905 (JINR-P-1559) BETA-RASPAD PIONA. (Beta Decay of the Pion). A. F. Dunaitsev, V. I. Petrukhin, Yu. D. Prokoshkin, and V. I. Rykalin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 15p.

Forty-three $\pi^+ \to \pi^0 + e^+ + \nu$ events were detected using Cherenkov spectrometers. A fast five-ray oscilloscope was used to identify events. The relative probability of beta decay was found to be $(1.1 \pm 0.2) \times 10^{-8}$, in agree-

ment with the conserved vector current hypothesis. The positron spectrum was also consistent with that predicted by theory. (auth)

20906 (JINR-P-1562) O PLOTHOSTI REZONANSOV PRI RASSEYANII NA SVYAZANNYKH CHASTITSAKH. (On Resonance Density in Scattering on Bound Particles). B. N. Zakhariev and S. N. Soklov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

The emergence of frequent resonances is demonstrated in the simple model in which a particle is scattered on the potential well occupied by another particle. The result obtained shows that the frequent resonances in the cross section for slow neutron scattering on nuclei can be understood on the basis of a considerably simpler mechanism of the reaction than the transfer of the energy of an incident particle to all the nucleons in the nucleus. (auth)

20907 (JINR-P-1564) ASIMPTOTICHESKIE SOOTNOSHENIYA MEZHDU AMPLITUDAMI RASSEYANIYA V RELYATIVISTSKOI LOKAL'NOI KVANTOVOI TEORII POLYA. (Asymptotic Relations Between Scattering Amplitudes in Relativistic Local Quantum Field Theory). Van Khieu Nguen (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 144p.

The results of numerous investigations of the asymptotic relations between the scattering amplitudes are stated in a systematic manner. These asymptotic relations are the consequences of the basic principles of relativistic local quantum field theory. 166 references. (auth)

20908 (JINR-P-1566) PERENORMIROVKA KVAZIPOTENTSIAL'NOGO URAVNENIYA DLYA SISTEMY DVUKH CHASTITS. (Renormalization of the Quasipotential Equation for the Two-Particle System). R. M. Faustov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 7p.

The construction of the quasipotential for the system of two particles with equal masses is considered. It is shown, that in the case of the renormalizable theories, where only self-energy diagrams and three-vertices diverge, the divergences of the quasipotential reduce to those of the S-matrix. (auth)

20909 (JINR-P-1572) KVHZIPOTENTSIAL'NYI METOD V ZADACHE OB UROVNYAKH ENERGII POZITRONIYA. (Quasipotential Method in the Problem About the Positronium Energy Levels). R. N. Faustov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 24p.

The bound state of the electron-positron system (positronium) is considered on the basis of the quasipotential method in quantum field theory. The magnitude of the splitting of the ground energy level of the positronium is obtained with the accuracy up to a^5 (a is the fine structure constant). The result is in agreement with earlier calculations. However, the new method simplifies essentially the whole procedure. (auth)

20910 (NP-13837) INTRODUCTORY COURSE ON ELEMENTARY-PARTICLE THEORY. Introductory Course Given by B. Laurent at Universitetets Institut for Teoretisk Fysik and NORDITA Copenhagen. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen). 1963. 131p.

Theory for the interactions and properties of elementary particles in the relativistic scattering approach is reviewed. Specifically, the s-matrix and dynamics are considered. (D.C.W.)

20911 (NP-13873) O REZONANSNYKH "OSOBENNOSTYAKH" V SISTEMAKH DVUKX BARIONOV. (Resonance "Singularities" in the Systems of Two Baryons). Yu. G. Bayukov, N. G. Birger, V. S. Borisov, L. L. Goldin, and G. A. Leksin (Akademiya Nauk S.S.S.R. Institut Teoreticheskoĭ i Eksperimental'noĭ Fiziki and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 15p.

The resonance singularities in systems of several baryons are discussed. Some experiments are suggested to observe such singularities and to investigate their properties. (auth)

20912 (PAN-468/VII) THE VARIATIONAL CALCULATION OF THE BINDING ENERGY OF THE ALPHA PARTICLE WITH THE VELOCITY-DEPENDENT POTENTIAL. J. Borysowicz and M. Zielińska (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Oct. 1963. 17p.

The upper bound for the binding energy of the alpha particle is calculated by the variation method. The velocity dependent potentials given by Green are used. The trial wave function used is in the form of a superposition of the S and D states. The calculated binding energies do not exceed 62% of the experimental value. The calculated radii exceed the experimental radius by at least 20%. The results indicate the importance of the two-nucleon correlations, not contained in the trial function considered. Also, the results are sensitive to the relative strength of the tensor and the central forces. (auth)

20913 (TID-20483) S-WAVE HYPERON-NUCLEON INTERACTIONS AND SU_3 SYMMETRY. Technical Report No. 361. P. D. DeSouza, G. A. Snow (Maryland. Univ., College Park); and S. Meshkov (National Bureau of Standards, Washington, D. C.). Mar. 1964. Contract AT (40-1)-2504. 12p.

The generalized Pauli principle is combined with the assumption of SU_3 symmetry to obtain relations between hyperon-nucleon and N-N scattering amplitudes for the $^1S_0$ and $^3S_1$ states. (auth)

20914 (TID-20488) DETERMINATION OF THE ORBITAL ANGULAR MOMENTA IN Σ^+ MESONIC DECAYS FROM RADIATIVE DECAYS. Technical Report No. 351. M. C. Li and G. A. Snow (Maryland. Univ., College Park). Jan. 1964. Contract AT(40-1)-2504. 9p.

It is shown that a measurement of the branching ratios for radiative hyperon (Σ^+) decays, $\Sigma^+ \rightarrow n + \pi^+ + \gamma$, can determine the s- or p-wave nature of nonradiative hyperon (Σ) decays $\Sigma^+ \rightarrow n + \pi^+$. (auth)

20915 (TID-20490) PHENOMENOLOGICAL ANALYSIS OF THE REACTIONS $\pi + N \rightarrow \pi_1 + \pi_2 + N'$ FROM THRESHOLD TO 700 Mev. Technical Report No. 358. M. Olsson and G. B. Yodh (Maryland. Univ., College Park). Feb. 1964. Contract AT(40-1)-2504. 33p.

The π^+-p interactions were analyzed by an extended Olsson-Yodh model which allows for the effects of any attractive phase shift that might exist between any two of the three final-state particles. The model explained the mass spectra and described the excitation functions for the single pion production processes. The model and its parameters are defined, and the determination of the parameters from experimental data is described. (D.C.W.)

20916 (UCRL-10773) THREE-BODY FINAL-STATE INTERACTIONS IN A SPECIAL CASE. A. C. Finn (Stanford Univ., Calif.) and V. L. Teplitz (California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 10, 1963. Contract W-7405-eng-48. 12p.

The problem of three simultaneous, two-body, final-state interactions in a three-body state is considered in the limiting case in which two of the interactions are long range and slowly varying. In this case the effect of the long-range interactions is merely to shift the energy at which the short-range interaction is to be evaluated. Applications are made to the determination of the s-wave π-π scattering length from the ^{3}He experiment and to production of resonant states. (auth)

20917 (UCRL-10786) MAXIMAL ANALYTICITY OF THE SECOND DEGREE. Geoffrey F. Chew (Middle East Technical Univ., Ankara; California. Univ., Berkeley. Lawrence Radiation Lab.; and California. Univ., Berkeley). Apr. 23, 1963. Contract W-7405-eng-48. 8p.

A different formulation of maximal, second-degree analyticity for the s-matrix is discussed that comprises the assumption that at all physical J values (total angular momentum), the actual s-matrix elements (for zero lepton number) coincide with an analytic continuation from large J. It is conjectured that the only s-matrix possessing both first- and second-degree analyticity is the observed strong-interaction s-matrix. (D.C.W.)

20918 (UCRL-10797) EVIDENCE FOR THE EXISTENCE OF A Kπ RESONANT STATE AT 726 Mev. Donald H. Miller, Gideon Alexander, Orin I. Dahl, Laurence Jacobs, George R. Kalbfleisch, and Gerald A. Smith (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). May 6, 1963. Contract W-7405-eng-48. 17p.

An investigation of the (K-π) effective-mass distributions in π^--p interactions at 1.51 to 2.36 Bev/c gave evidence for the existence of a weakly coupled unstable state with strangeness s = +1, mass 726 ± 3 Mev, and full width $\Gamma \lesssim$ 20 Mev. The data support an isotopic spin assignment of $\frac{1}{2}$. (D.C.W.)

20919 ARE THERE TWO NEUTRINOS OR ONLY ONE? G. Marx (Roland Eoetvoes Univ., Budapest). Acta Phys. Austriaca, 17: 231-9(1964). (In German)

A review is presented on the question: can the electron neutrino and the muon neutrino be conceived as different states of a single elementary particle or not? (tr-auth)

20920 CONTRIBUTIONS TO THE THEORY OF NONSTATIONARY, MULTIPLE COMPTON SCATTERING OF γ QUANTA. V. V. Zaitsev and S. A. Kaplan. At. Energy (USSR), 16: 149-50(Feb. 1964). (In Russian)

Even in the first approximation of the calculation of the nonstationary character, the condition $\cos\theta = 1$, with θ the angle of scattering of the γ quanta, cannot be applied because in that case the spreading of the γ quanta bunch, which is emitted at the same time by the source, is not taken into account. Therefore, in an attempt to develop a simple calculation scheme for the nonstationary scattering of γ quanta, the condition $\cos\theta = 1 - (\theta 2/2)$ was used for the calculation, which referred to the case of a flat, unidirectional source, emitting γ quanta. The aim of the study was the determination of the γ flux, i.e., the number of quanta possessing a given wavelength passing through the unit surface per second at a given distance. A simplified expression was obtained in which the order of the scattering was indicated by an approximate exponent. (TTT)

20921 INTEGRAL EQUATION FOR PHOTOPRODUCTION OF PION ON PION. A. D. Alimov and L. Sh. Khodzhaev (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser, Fiz.-Mat. Nauk, No. 6, 51-7(1963). (In Russian)

An integral equation for $\gamma\pi \rightarrow \pi\pi$ amplitudes was developed using the Mandelstam concept and Cini-Fubini approximations. It was concluded that a differential method should offer more accurate results. Moreover, consideration of lower partial waves and neglect of higher waves do not result in substantial error. (R.V.J.)

20922 MATRIX ELEMENTS OF THE OCTET OPERATOR OF SU_3. D. Lurié and A. J. MacFarlane (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 5: 565-75(May 1964).

All the nonvanishing matrix elements of all the components of the tensor operator which belongs to the regular representation (the octet) of SU_3 were evaluated. Of special interest is the component Y, for it is usual in the broken unitary symmetry theory of strong interactions to assume that the interactions which break exact SU_3 invariance have the same transformation properties as Y. Previously, matrix elements of Y connecting states of the same irreducible representation of SU_3 were given by Okubo in the mass formula. Knowledge of all the matrix elements of Y is essential, however, if one is to do more than evaluate one-particle matrix elements in the broken unitary symmetry theory. This method provides such knowledge for all components of the octet tensor operator with little more effort than is needed to treat Y alone. (auth)

20923 STUDY OF EXACTLY SOLUBLE ONE-DIMENSIONAL N-BODY PROBLEMS. J. B. McGuire (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.), 5: 622-36(May 1964).

It is shown that several cases of one-dimensional N-body problems are exactly soluble. The first case describes the motion of three one-dimensional particles of arbitrary mass which interact with one another via infinite-strength, repulsive delta-function potentials. It is found that the stationary-state solution of the scattering of the three particles is analogous to an electromagnetic diffraction problem which has already been solved. The solution to this analogous electromagnetic problem is interpreted in terms of particles. Next, it is shown that the problem of three particles of equal mass interacting with each other via finite- but equal-strength delta-function potentials is exactly soluble. This example exhibits rearrangement and bound-state effects, but no inelastic processes occur. Finally it is shown that the problem of N particles of equal mass all interacting with one another via finite- but equal-strength delta functions is exactly soluble. Again no inelastic processes occur, but various types of rearrangements and an N-particle bound state do occur. These rearrangements and the N-particle bound state are illustrated by means of a series of sample calculations. (auth)

20924 MULTIPLE SCATTERING IN THE DIFFUSION APPROXIMATION. E. E. Salpeter (Cornell Univ., Ithaca, N. Y.) and S. B. Treiman. J. Math. Phys. (N. Y.), 5: 659-68(May 1964).

The passage of classical particles through a grainy scattering medium can be described by a linearized Boltzmann equation. A discussion is given of the physical conditions which justify the use of the Fokker-Planck diffusion approximation to this equation. Some limiting properties of the solutions of the diffusion equation are first discussed for the initial value problem in an infinite medium characterized by a diffusion length D. For a total path length $l \ll D$ convenient formulas are given for the distribution of scattering angles θ, and, for given θ, the first few moments of the final position vector are computed. These results are taken as a basis for approximate treatment of steady-

state boundary value problems. The case of a particle beam incident on a thin plane parallel slab of thickness $d \ll D$ is considered. Approximate formulas are given for the angular distribution of the transmitted beam and for the (very small) fraction of the beam which emerges from the entrance face. Errors are assessed, and the behavior for grazing angles of incidence or exit is discussed in a conjectural way. (auth)

20925 SEPARATION OF FAST PARTICLES BY MEANS OF H. F. ELECTROMAGNETIC FIELDS. R. Hirel (Faculté des Sciences, Orsay, France). Nucl. Instr. Methods, 26: 90-2(Feb. 1964). (In French)

A periodic circular structure with iris, which propagates the TM_{11} mode at 3000 Mc, is studied to separate relativistic particles of same momentum but of mass and speed lightly different. The fundamental TM_{11} mode wave is in synchronism with particles and gives to them a deflection which depends on the time of arrival of particles in the structure. Measurement has been done with a structure 50 cm long and 0.3 kw peak power, which gives ±10 mm deflection on particles of 0.4 Mev energy. (auth)

20926 EFFECT OF FINAL-STATE INTERACTIONS ON CROSS-SECTION FOR PROCESS $K^- + d \rightarrow \overline{K}^0 + 2n$. P. A. Cook (Univ. of Manchester, Eng.). Nuovo Cimento (10), 31: 1364-7(Mar. 16, 1964).

Cross sections were calculated for $K^- + d \rightarrow \overline{K}^0 + 2n$ at K^- momentum of 100 to 150 Mev/c considering the final-state neutron interactions. (R.E.U.)

20927 ON THE PRODUCTION OF THE F^{5}_{5} PION-NUCLEON ISOBAR IN PERIPHERAL PROTON-PROTON COLLISIONS. E. Ferrari (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 31: 1372-5(Mar. 16, 1964).

The peripheral production of the F^{5}_{5} isobar (1922 Mev, $T = 3/2$) in $p + p \rightarrow p + n + \pi^+$ reactions was studied from energy distributions of the π^+ at fixed angle in the c.m. system. The spectra were calculated in the one-pion-exchange model with the use of a single approximate cut-off on the squared four-momentum of the intermediate pion. (R.E.U.)

20928 FURTHER OBSERVATION OF ELECTRONS IN ANTINUCLEON ANNIHILATION STARS AND THE POSSIBLE EXISTENCE OF A SECOND NEUTRAL PION. Tsai-Chu, C. Simonin-Haudecoeur, D. Schune-Boisblé, and B. Brami-Dépaux (Faculté des Sciences, Paris). Nuovo Cimento (10), 31: 1376-9(Mar. 16, 1964).

The study of antineutron annihilation electron showers in K-5 emulsion exposed to 740-Mev/c antiprotons and the conclusion that there is possible existence of a second neutral pion are discussed. (R.E.U.)

20929 A SIMPLE RANGE-ENERGY-RELATION FOR ELECTRONS IN THE ENERGY REGION OF 3 kev TO 3 Mev. K.-H. Weber (VEB Vakutronik, Dresden). Nucl. Instr. Methods, 25: 261-4(Jan. 1964). (In German)

Starting from an approximation formula for the stopping power of electrons there is derived a semi-empirical range-energy relation for electrons of the form $R = A\,E[1-B(1+CE)^{-1}]$, which represents the known experimental data of electron ranges in the region 3 kev to 3 Mev with accuracy. The constants A, B, and C are determined by comparison with known empirical approximation formulae for true and maximal ranges of monoenergetic electrons and β particles and for extrapolated ranges of monoenergetic electrons in aluminum. (auth)

20930 BETHE-SALPETER STRUCTURE OF THE NON-RELATIVISTIC THREE-NUCLEON PROBLEM. P. Stichel (Universität, Hamburg). Nucl. Phys., 52: 189-212(Mar. 1964).

In the framework of potential theory, an exact integral equation for the off mass shell nucleon-deuteron scattering amplitude is derived. The kernel of this integral equation is free from one- and two-particle singularities in the total energy and can be expressed in terms of the deuteron vertex function and that part of the two-nucleon scattering amplitude having no one-particle singularities in the energy. This form of the integral equation utilizes a part of the Bethe-Salpeter (BS) structure of the elastic scattering amplitude. The inelastic nucleon-deuteron scattering amplitude, which can be expressed by terms already contained in the elastic scattering problem, is discussed. The inelastic scattering amplitude consists of two parts: the deuteron break-up off the mass shell and initial- and final-state scattering contributions, where the latter are again free from one- and two-particle singularities in the total energy. This BS structure of the elastic and inelastic nucleon-deuteron scattering amplitude serves as a basis for an approximation scheme satisfying full unitarity in the sector with nucleon number 3. These approximations are a unitary generalization of the impulse approximation. (auth)

20931 BARYONS AND LEPTONS AND GROUP SU_4. W. Królikowski (Inst. for Nuclear Research, Warsaw and Univ. of Warsaw). Nucl. Phys., 52: 342-4(Mar. 1964).

The regular representation of the unitary unimodular group in four dimensions (SU_4) is pointed out as a possible frame for a common classification of baryons and leptons. (auth)

20932 ON THE USE OF MONTE CARLO METHODS FOR SOLVING GAMMA RADIATION TRANSPORT PROBLEMS. Martin Leimdoerfer (Aktiebolaget Atomenergi, Stockholm). Nukleonik, 6: 14-19(Feb. 1964).

A description is given of various Monte Carlo programs that were developed for the Ferranti Mercury Computer solving gamma backscattering and penetration problems in plane, spherical, and cylindrical geometries. The energy region covered is 10 Mev to 10 kev. Results of several sample problems of interest in radiation physics and reactor shielding are presented. (auth)

20933 MEASUREMENT OF THE TRIPLE-SCATTERING PARAMETER D_t IN THE FREE n-p SYSTEM AT 170°. W. G. Collins, Jr., and D. G. Miller (Harvard Univ., Cambridge, Mass.). Phys. Rev., 134: B575-7(May 11, 1964).

The triple scattering parameter D_t in the free n-p system was measured at a center-of-mass angle of 170°, using a 128-Mev polarized neutron beam. The value found is -0.283 ± 0.209, which supports the strong negative value of the parameter predicted by the several phase-shift solutions of Breit, et al., of Yale. This value, together with the values found by Patel, et al., in 1962, discriminates sharply against solutions other than YLAN3M. (auth)

20934 MEASUREMENT OF NEUTRON-PROTON POLARIZATION AT 126 Mev. A. S. Carroll, P. M. Patel, N. Strax, and D. Miller (Harvard Univ., Cambridge, Mass.). Phys. Rev., 134: B595-600(May 11, 1964).

The n-p polarization at 126 Mev was measured between 33 and 82° c.m. by scattering a 41% polarized neutron beam from liquid hydrogen. The energy threshold and angle of scattering were determined by a range-threshold neutron counter. By the use of a conjugate counter to detect the recoil protons in coincidence with the scattered neutrons, the background rate was held to about 10%. Many systematic errors were eliminated by the use of precession magnets

to reverse the sign of the neutron polarization. The maximum polarization was found to be 0.580 ± 0.040 at 56° c.m. This maximum is higher than that obtained in any of the Yale phase-shift predictions. (auth)

20935 TESTS OF THE ONE-PION-EXCHANGE MODEL. Alfred S. Goldhaber (Princeton Univ., N. J.). Phys. Rev., 134: B600-4(May 11, 1964).

The original Chew-Low proposal of a pion pole in the collision matrix at unphysical momentum transfer has evolved into a "generalized Born approximation" for one-pion exchange. This predicts that the collision amplitude will be independent of the total center-of-mass energy W for the reaction. Tests of this prediction are described for the process $\pi + N \rightarrow N + 2\pi$, where the final dipion mass is in the vicinity of the ρ resonance at 750 Mev, using data for incoming pion momenta of 1.4, 1.7, and 3.0 Bev/c. The results agree with the model except for a variation with W of the angular distribution of the dipion decay with respect to the incident π direction. (auth)

20936 ZERO-ENERGY INTERCEPTS OF THE ρ AND R TRAJECTORIES, THE pn CHARGE-EXCHANGE SCATTERING, AND THE DIFFERENCE IN pp AND np TOTAL CROSS SECTIONS. Akbar Ahmadzadeh (Univ. of California, Berkeley). Phys. Rev., 134: B633-5(May 11, 1964). (UCRL-11164)

It is shown that the existing high-energy data for the np charge-exchange differential cross section in the forward direction and the difference between np and pp total cross sections can be simultaneously explained in terms of two Regge trajectories. The two trajectories are the ρ and the R. The R has parity and G parity opposite to ρ but the same isotopic spin. These two sets of quantum numbers in the crossed channel are the only possible ones with nonvanishing contribution to the processes in question. The conjecture of real analyticity of the generalized coupling constants, together with the existing data, requires the existence of an R trajectory. In fitting the experimental data the intercepts are $\alpha_\rho(0) = 0.57 \pm 0.1$ and $\alpha_R(0) = 0.31 \pm 0.05$. (auth)

20937 DETERMINATION OF PION-NUCLEON S-WAVE SCATTERING LENGTHS BY THE N/D METHOD. S. K. Bose and S. N. Biswas (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 134: B635-7(May 11, 1964).

The pion-nucleon S-wave scattering lengths are calculated using the method originally developed by Balázs, wherein an effective-range two-pole approximation is made for the numerator function. The residues of the effective-range poles are determined by matching the amplitude and its derivative with those calculated with a fixed energy dispersion relation. In calculating the latter the contribution of only the N* and ρ, together with those of appropriate nucleon-pole terms, are retained. The calculated scattering length in the $T = \frac{3}{2}$ state is in excellent agreement with experimental result, while for the $T = \frac{1}{2}$ state, the calculated value, though of the right sign, is about twice the experimental scattering length. (auth)

20938 PRODUCTION OF HYPERFRAGMENTS BY THE INTERACTION OF 1.5-Gev/c K^- MESONS IN LITHIUM-LOADED EMULSIONS. M. J. Beniston, R. Levi Setti, W. Pueschel, and M. Raymund (Univ. of Chicago). Phys. Rev., 134: B641-8(May 11, 1964).

Hyperfragment production by some 31,000 interactions of 1.5-Bev/c K^- mesons in lithium-loaded K5 nuclear emulsions was studied and compared with data from 0.8-Bev/c and existing data from 1.5-Bev/c K^- interactions in normal emulsions. The study of the prong number distributions of the hyperfragment parent stars provides a sensitive method for determining the production rates of hyperfragments by K^- interactions with light (C,N,O) and heavy (Ag,Br) emulsion nuclei; these production rates are found to be (0.66 ± 0.11) and (5.20 ± 0.20)%, respectively. An appreciable proportion of mesonic hyperfragments ($Z < 6$) and ^{8}Li fragments have very short ranges ($R_{HF} \leq 10\ \mu$); this fact indicates the possibility of contaminations of "light" hypernuclides among the assumed mesic spallation hyperfragments. The predominant part of the hyperfragment production stars which shows the emission of "short" prongs involves the disintegration of heavy nuclei, thus indicating that Coulomb-barrier criteria cannot be used in discriminating among light or heavy hyperfragment parent stars at high K^- momenta. No double hyperfragment was observed. One K^- interaction emitted two hyperfragments decaying nonmesically. The π^+ decay of a $^4_\Lambda$He hyperfragment was found. An estimate of the branching ratio R of the π^+ decay and π^- decay modes for the $^4_\Lambda$He hypernucleus gives $R \leq (2.7 \pm 1.1)\%$. (auth)

20939 OCTET MASS VECTOR. Richard H. Capps (Northwestern Univ., Evanston, Ill.). Phys. Rev., 134: B649-51(May 11, 1964).

It is shown that the concept of the octet mass vector, introduced previously by Glashow, may be used to provide an unambiguous criterion for the accuracy of the various mass sum rules that have been proposed on the basis of unitary symmetry. This criterion is applied to the experimental baryon and pseudoscalar meson masses. The electromagnetic mass splittings are discussed in detail. It is shown that the observed mass splittings correspond closely to the types that are favored in a simple bootstrap model, if the F/D interaction angle for the meson-baryon interactions is set equal to a value suggested by other considerations. (auth)

20940 MODEL FOR THE NUCLEON AND BARYON REGGE TRAJECTORIES. Daniel Z. Freedman (Univ. of Wisconsin, Madison). Phys. Rev., 134: B652-8(May 11, 1964).

A model for pion-nucleon scattering is considered that may permit a unified dynamical explanation of the low-energy properties of the nucleon Regge trajectory and the higher $T = \frac{1}{2}$ resonances on that trajectory. The basis of the model is a field-theoretic graph, which contains a vector meson and a nucleon in the intermediate state. The lowest order N/D method is used to construct a unitary scattering amplitude that contains a Regge trajectory. The trajectory passes through $J = \frac{1}{2}$ when the total energy is equal to the nucleon mass and has a reasonable slope. When generalized to an SU_3 invariant theory of baryon, pseudoscalar meson, and vector meson octets, the model predicts a value $\alpha = 0.427$ for the coefficient of F-type Yukawa coupling, and suggests that a unitary singlet Y_0^* resonance of spin-parity $D_{\frac{3}{2}}$ exists. The relation between the N/D and Fredholm methods is discussed and the important role played by the factorability of the Born amplitudes is pointed out. (auth)

20941 DEPARTURES FROM THE EIGHTFOLD WAY: THEORY OF STRONG INTERACTION SYMMETRY BREAKDOWN. Sidney Coleman and S. L. Glashow (Harvard Univ., Cambridge, Mass.). Phys. Rev., 134: B671-81(May 11, 1964).

The three kinds of departure from exact unitary symmetry are considered: medium-strong interactions that leave only isospin and hypercharge as good symmetries, electromagnetism, and weak interactions. The existence of an

octet of scalar mesons that give the possibility of symmetry-breaking tadpole diagrams is postulated. Our fundamental dynamical assumption—that symmetry-violating processes are dominated by symmetry-breaking tadpole diagrams—gives an immediate explanation of the success of two empirical laws: the Gell-Mann-Okubo mass formulas and the nonleptonic $\Delta I = \frac{1}{2}$ rules. Including tadpole diagrams and some other electromagnetic corrections, the six electromagnetic mass splittings of mesons and baryons are calculated in terms of a single unknown parameter correctly to within 0.5 Mev. (auth)

20942 BACKWARD ANGLE FERMION-BOSON SCATTERING. Douglas S. Beder (California Inst. of Tech., Pasadena). Phys. Rev., 134: B698-701(May 11, 1964).

In a Regge-type treatment of fermion-boson reactions, backward-angle differential cross sections are dominated by complex conjugate pairs of u-channel Regge trajectories (this is true for spins $\frac{1}{2}$ and 0 or 1, and probably in general). It is demonstrated here that generally, these differential cross sections and associated final-state polarizations will not exhibit oscillatory behavior as a function of u and s, in spite of interferences between the poles of such complex conjugate pairs. This result is in agreement with previous findings in the special case of π-N scattering. (auth)

20943 THEORY OF ELECTRON BACKSCATTERING. Roger F. Dashen (Sandia Lab., Albuquerque, N. Mex.). Phys. Rev., 134: A1025-32(May 18, 1964).

An exact integral equation is derived for the backscattering coefficient as a function of energy and angle. The equation has an approximate symmetry which allows one to determine the conditions under which backscattering will be independent of the energy of the incident electrons. The validity of some approximations is discussed, and a possible method for obtaining numerical solutions is proposed. It is found that small- and large-angle individual scatterings are of about equal importance. For those electrons that have lost very little energy, the equation can be solved exactly, and some interesting results are obtained. (auth)

20944 FEYNMAN RULES FOR ANY SPIN. II. MASSLESS PARTICLES. Steven Weinberg (Univ. of California, Berkeley). Phys. Rev., 134: B822-96(May 25, 1964).

The Feynman rules are derived for massless particles of arbitrary spin j. The rules are the same as those presented earlier for $m > 0$, provided that $m \to 0$ in propagators and wave functions, and provided that we keep to the $(2j + 1)$-component formalism [with fields of the $(j,0)$ or $(0,j)$ type] or the $2(2j + 1)$-component formalism [with $(j,0) \oplus (0,j)$ fields]. But there are other field types that cannot be constructed for $m = 0$; these include the $(j/2,j/2)$ tensor fields, and in particular the vector potential for $j = 1$. This restriction arises from the non-semisimple structure of the little group for $m = 0$. Some other subjects discussed include: T, C, and P for massless particles and fields; the extent to which chirality conservation implies zero physical mass; and the Feynman rules for massive particles in the helicity formalism. Our approach is based on the assumption that the S matrix is Lorentz invariant, and makes no use of Lagrangians or the canonical formalism. (auth)

20945 INELASTIC ELECTRON-DEUTERON SCATTERING EXPERIMENTS AND NUCLEON STRUCTURE. C. de Vries (Stanford Univ., Calif.), R. Hofstadter, A. Johansson, and Robert Herman. Phys. Rev., 134: B848-59(May 25, 1964).

Inelastic electron-scattering experiments are reported for four-momentum transfers from 3.0 to 22.0 F^{-2}. The results of these measurements were combined with values of proton cross sections measured in the same region of q^2 and were analyzed in terms of a three-pole Clementel-Villi model for the isotopic form factors. Parameters appearing in this model were adjusted by statistical methods. The minimum values of χ^2 obtained show that the different blocks of information on elastic electron-proton and inelastic electron-deuteron cross sections measured at Stanford are consistent with each other. An important result of the analysis is that the cross sections cannot be fitted with only one $T = 1$, $J = 1$ multipion resonance, unless the effective mass of such a particle is taken to be approximately 600 Mev. This value is considerably lower than the accepted mass of the ρ resonance. On the whole the agreement with other data on the proton form factors and neutron form factors is rather good, although there is still some disagreement with results on the charge form of the neutron. (auth)

20946 PSEUDOSCALAR CHARGE DENSITY OF SPIN-$\frac{1}{2}$ PARTICLES. II. OBSERVABILITY. K. Hiida (Argonne National Lab., Ill.). Phys. Rev., 134: B860-3(May 25, 1964).

To show clearly that the pseudoscalar charge density is a physical observable, the influence of the pseudoscalar charge density on the spin orientation of a charged spin-$\frac{1}{2}$ particle in time-independent electric and magnetic fields is considered. The following results are found: (I) Longitudinal electric field. Because of the interaction of the pseudoscalar charge density with the field, the spin rotates about the axis perpendicular to the direction of propagation and the spin orientation. (II). Transverse electric field. The interaction of the pseudoscalar charge density with the field causes the spin to rotate about the axis perpendicular to the spin and the direction of the field. The interaction of the usual scalar charge density with the field causes the spin to rotate about the axis perpendicular to the direction of propagation and the field. At very low energies, the spin can be rotated through a larger angle in the former case than in the latter. (III). Longitudinal and transverse magnetic fields. There is no interaction between the induced pseudovector current and the magnetic fields. (auth)

20947 MIXING OF ELEMENTARY PARTICLES. Sidney Coleman (Harvard Univ., Cambridge, Mass.) and Howard J. Schnitzer. Phys. Rev., 134: B863-72(May 25, 1964).

Particle mixing is studied in a field-theoretic context, as a further approximation to the pole approximation. Although particle mixing is well suited for treating spinless particles, another approximation, also a further approximation to the pole approximation, called vector mixing, is better for treating particles of spin one. Vector mixing is applied to several processes involving the mixing of the ω and ϕ by the interaction that breaks unitary symmetry. (auth)

20948 NUCLEON AND THE PIÓN-NUCLEON TRAJECTORY. DETERMINATION OF THE PION-NUCLEON COUPLING CONSTANT. A. O. Barut and J. Dilley (Univ. of Colorado, Boulder). Phys. Rev., 134: B873-6(May 25, 1964).

The low-energy p-wave pion-nucleon scattering amplitude is represented by a single Regge pole in the direct channel with correct analytical properties. The three parameters of the trajectory at threshold were determined. From the residue of the pole at the nucleon position the πN

coupling constant is determined to be $g^2 = 13.68$. The agreement at high energies is poor. A possible explanation of the discrepancy is that the analytically continued partial-wave amplitude at $J = \frac{1}{2}$ does not coincide with the physical amplitude. The difference is shown, from unitarity, to be approximately given at threshold by the contribution of an elementary nucleon pole. With such a term a good agreement is obtained up to 100 Mev with Woolcook's data and g^2 is found to be 13.03. (auth)

20949 SOME REMARKS ON ω AND φ MESON WIDTHS AND R-CONJUGATION INVARIANCE IN STRONG INTERACTION. Ken Kawarabayashi (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev., 134: B877-81(May 25, 1964).

It is pointed out that partial widths of two neutral vector mesons, ω and φ, decaying into three pions provide some information for or against R-conjugation invariance in strong interaction. A particular model is considered in detail, in which ω and φ mesons are R-conjugation invariantly associated with baryonic charge and hypercharge currents, respectively. This model is shown to explain consistently various phenomena involved in production and decay processes of these vector mesons. (auth)

20950 POSSIBLE EFFECTS OF STRONG INTERACTIONS IN FEINBERG-PAIS THEORY OF WEAK INTERACTIONS. [PART] II. N. P. Chang (Inst. for Advanced Study, Princeton, N. J.) and H. S. Mani. Phys. Rev., 134: B896-900(May 25, 1964).

In a previous paper, a simplified model was used to study the effects of strong interactions on the weak interaction theory of Feinberg and Pais. A power count based upon the Ward-Takahashi-Nishijima multimeson vertex function identity is used to show that the same conclusion remains valid even when crossed ladder graphs are included. The conclusion may not apply, however, to the modified program of peratization where W−W scattering plays an essential role. (auth)

20951 π^-p INTERACTIONS AT 10 Gev/c WITH FOUR CHARGED SECONDARIES. N. N. Biswas, I. Derado, N. Schmitz, and W. D. Shephard (Max-Planck-Institut für Physik und Astrophysik, Munich). Phys. Rev., 134: B901-11(May 25, 1964).

About 800 π^-p interactions with four charged secondaries produced by 10.25-Bev/c negative pions in the 81 cm. Saclay hydrogen bubble chamber were analyzed. The cross sections for the various reactions, including the production of N*, ρ, and ω are given. The c.m.-system angular and momentum distributions are discussed; the nucleons are strongly peaked backward whereas the pions, especially the π^-, go predominantly forward. Values for the average transverse momentum of the various secondary particles were determined. From plots of the average transverse momentum versus the c.m. longitudinal momentum correlations between the momentum p* and the scattering angle Θ^* can be seen; it is found that p* is essentially proportional to the inverse of sin Θ^*. The occurrence of resonant states has been investigated. Production of ρ^0 seems very important at this energy in the $p\pi^-\pi^+\pi^-$ final state. Production of N^{*++} is relatively more important in final states involving additional pions and a proton. (auth)

20952 PARTICLES WITH A CHARGE OF $\frac{1}{3}$e. L. P. Leipuner (Brookhaven National Lab., Upton, N. Y.), W. T. Chu, R. C. Larsen, and Robert K. Adair. Phys. Rev. Letters, 12: 423-5(Apr. 13, 1964). (BNL-7899)

A detection system consisting of seven plastic scintillation counters was used along with the AGS in a search for quarks of charge $-\frac{1}{3}$e. Following the assumptions that the electromagnetic coupling is the only coupling of importance for production and that the quark-nucleon total cross section is not larger than a few millibarns, the ratio of quark-pion production was estimated. The experimental results indicated a quark-pion ratio less than $^5/_{10}{}^{10}$ and a cross section for quark production by 28-Bev protons on nucleons $<10^{-34}$ cm^2. It is established that quarks do not exist with a mass less than 2 Bev/c^2. (L.B.S.)

20953 ANTIPROTON-PROTON COLLISION IN THE UNITARY SYMMETRY MODEL. M. Konuma (Scuola Normale Superiore, Pisa, Italy) and Y. Tomozawa. Phys. Rev. Letters, 12: 425-8(Apr. 13, 1964).

The validity of the octet model with complete symmetry was tested for baryon pair production in antiproton-proton collisions. Calculations of the transition amplitudes from the S matrix lead to an inequality. Using experimental values for reduced cross sections for $\bar{p}p \to \bar{X}Y$ processes and assuming charge-conjugation and time-reversal invariance, it is shown that the prediction of the octet model with complete symmetry is not in agreement with experiment. The relations among the transition amplitudes for meson pair production in the Sakata model are also obtained. (L.B.S.)

20954 K^- p ELASTIC SCATTERING AT 2.00 Bev/c. R. Crittenden (Univ. of Indiana, Bloomington), H. J. Martin, W. Kernan, L. Leipuner, A. C. Li, F. Ayer, L. Marshall, and M. L. Stevenson. Phys. Rev. Letters, 12: 429-32 (Apr. 13, 1964).

The DATPRO program was used to analyze K^--p elastic scattering events obtained in the Brookhaven 20-in. bubble chamber. The accepted events showed a distribution of the χ^2 probability function appropriate to a four-constraint requirement on the energy and momentum relations. The number of elastic events and elastic cross sections are listed for each angular interval in the barycentral system. Differential elastic scattering cross sections are shown as a function of the square of the total transverse momentum in the manner of Serber and Kirsch. (L.B.S.)

20955 APPROXIMATE UNITARY SYMMETRY AND THE PARITY QUESTION. A. Pais (Rockefeller Inst., New York). Phys. Rev. Letters, 12: 432-5(Apr. 13, 1964).

Approximate unitary symmetry together with considerations of gauge invariance and minimality of interactions is discussed in an attempt to answer the parity question. It is assumed that CP invariance is a universal law involving parity and characteristic properties of strong and electro magnetic interactions, which lead to P conservation, but does not apply to weak interactions. (L.B.S.)

20956 ABSOLUTE DECAY RATE FOR $K_2^0 \to \pi^+ + \pi^- + \pi^0$ AND THE $|\Delta I| = \frac{1}{2}$ RULE. Donald Stern (Univ. of Wisconsin, Madison), Thomas O. Binford, V. Gordon Linn, Jared A. Anderson, Frank S. Crawford, Jr., and Robert L. Golden. Phys. Rev. Letters, 12: 459-62(Apr. 20, 1964).

The absolute decay rate for $K_2^0 \to \pi^+ + \pi^- + \pi^0$ was measured. The result agrees with that predicted by the $|\Delta I| = \frac{1}{2}$ rule. (M.J.T.)

20957 TESTS FOR SPIN AND PARITY OF THE B MESON. M. Ademollo, R. Gatto, and G. Preparata (Universita, Florence and CNEN, Romeí. Phys. Rev. Letters, 12: 462-5(Apr. 20, 1964).

Sets of test functions for determining the spin and decay parameters of the B meson, a π-ω resonance, are derived. (M.J.T.)

20958 MODEL FOR THE $\pi\omega$ RESONANCE AT 1220 Mev. T. K. Kuo (Brookhaven National Lab., Upton, N. Y.).

Phys. Rev. Letters, 12: 465-7(Apr. 20, 1964). (BNL-7765)

The force contribution of ρ exchange to the 2^- and 1^+ states of the $\pi\omega$ resonance is considered, for both s-wave and p-wave scattering. (M.J.T.)

20959 PROPERTIES OF Ξ HYPERONS. D. Duane Carmony, Gerald M. Pjerrou, Peter E. Schlein, William E. Slater, Donald H. Stork, and Harold K. Ticho (Univ. of California, Los Angeles). Phys. Rev. Letters, 12: 482-4 (Apr. 27, 1964).

Meson (K^-) reactions in a hydrogen bubble chamber at 1.80 and 1.95 Bev/c were used to investigate properties of the hyperon (Ξ^-). The number of events observed at each momentum and the total cross sections are listed. The Ξ^- mean life was computed, and the decay asymmetry parameters are illustrated. The $\Xi^0 - \Xi^-$ mass difference was obtained. (C.E.S.)

20960 OBSERVATION OF $f^0 \rightarrow 2\pi^0$. L. Sodickson, M. Wahlig, I. Mannelli, D. Frisch, and O. Fackler (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 12: 485-7(Apr. 27, 1964). (TID-20462)

The $f^0 \rightarrow 2\pi^0$ decay mode was observed in the reaction $\pi^- + p \rightarrow f^0 + n$ at an incident momentum of 10 Bev/c. It is concluded that the f^0 has even spin and positive parity. (C.E.S.)

20961 STUDY OF THE $K_{\mu 3}$ DECAY SPECTRUM. V. Bisi, G. Borreani, R. Cester, et al. (Istituto Nazionale di Fisica Nucleare, Turin and Università, Turin). Phys. Rev. Letters, 12: 490-3(Apr. 27, 1964).

The branching ratio and meson (μ^+) energy spectra were determined for the decay $K^+ \rightarrow \mu^+ + \pi^0 + \nu$. The method used was the measurement of the meson (μ^+) stopping range in hydrogen and heavy liquid chambers. (C.E.S.)

20962 PROPOSAL OF EXPERIMENTAL TEST OF THE UNITARY SYMMETRY MODEL WITH SYMMETRY-BREAKING INTERACTION. M. Konuma (Scuola Normale Superiore, Pisa, Italy) and Y. Tomozawa. Phys. Rev. Letters, 12: 493-5(Apr. 27, 1964).

The relations between meson–nucleon scattering amplitudes are considered as an experimental test of the unitary symmetry model with the symmetry breaking interaction T_3^3. Consideration of the symmetry-breaking interaction leads to the Gell-Mann-Okubo mass formula in the octet model. Proton interactions with mesons (K^-) and (π^-) are discussed. (C.E.S.)

20963 DIFFUSION OF PROTONS (TRITONS) IN ICE CRYSTALS. Ottmar Dengel and Nikolaus Riehl (Technische Hockschule, Munich). Physik Kondensierten Materie, 1: 191-6(1963). (In German)

The diffusion coefficient of tritons in ice crystals was measured at different temperatures between 0 and −35°C. The applied method excludes any surface diffusion. The absolute value of the diffusion coefficient at −7°C was determined as 2×10^{-11} cm^2/sec (±10%) and the activation energy as 13.5 kcal/mole (±8%). The activation energy of proton (triton) diffusion was therefore consistent with the activation energy found for the dielectric and mechanical relaxation of protons in ice. The importance of this consistency relative to the diffusion mechanism is discussed. (auth)

20964 SINGLE PION PRODUCTION IN PION-NUCLEON SCATTERING. F. Mandl and B. R. Pollard (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 83: 597-610(Apr. 1964).

A model for single pion production, $\pi + N \rightarrow \pi + \pi + N$, which includes a pion–pion interaction in the $(^3/_2, ^3/_2)$, channel in the final state, is described. A static model hamiltonian with the addition of direct π-π interaction terms is used. The lowest order amplitude is obtained by selecting the appropriate graphs, and a simple method is used to introduce the resonant final-state interaction into the lowest order graphs. There are two parameters in the theory that are related to the s- and p-wave π-π scattering lengths, a_0 and a_1. These are determined by fitting the theory to the observed total cross sections for the process $\pi^+ + p \rightarrow \pi^+ + \pi^- + n$ in the energy range from threshold to 450 Mev. The scattering lengths are found to be $a_0 = -0.046\ \mu^{-1}$ and $a_1 = 0.016\ \mu^{-1}$. The fit to the observed energy distributions indicates a value for the ratio a_1/a_0 slightly different from that for the total cross section. The fit to the angular distributions is less satisfactory. The reason for this is discussed in relation to an approximation made in evaluating the production amplitude. 32 references. (auth)

20965 RECENT EXPERIMENTS WITH THE C.E.R.N. SYNCHRO-CYCLOTRON. C. Rubbia (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 278: 323-31(Apr. 7, 1964).

Experiments performed with the CERN proton synchrotron that yield new information about the weak and electromagnetic properties of the π and μ mesons are described. The $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ decay mode, capture of μ^- by hydrogen, and the anomalous magnetic moment of μ^+ are considered. (R.E.U.)

20966 RECENT EXPERIMENTS WITH NUCLEAR EMULSIONS. E. H. S. Burhop (University Coll., London). Proc. Roy. Soc. (London), Ser. A, 278: 350-69(Apr. 7, 1964).

Nuclear emulsion techniques and their application with high-energy accelerators are discussed. The study of short-range hyperfragments and the binding of the Λ^0 in nuclear matter, the discovery of a double hyperfragment, measurement of small-angle p-p scattering, measurement of cross sections for low-energy particle interactions, and the use of pulsed magnetic fields in nuclear emulsion experiments are discussed. (R.E.U.)

20967 SOME MOTIVATIONS FOR A VERY COSTLY LONG-RANGE PROGRAMME ON HIGH-ENERGY NEUTRINO PHYSICS AT C.E.R.N. G. Bernardini (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 278: 369-90 (Apr. 7, 1964).

A discussion is presented of neutrino physics in electron decay, $\mu^\pm$ decay, and other weak interactions. The Fermi interaction hypothesis is discussed. (R.E.U.)

20968 INFORMATION ON STRONG INTERACTIONS FROM RESEARCH ON COSMIC RAYS. N. A. Dobrotin and E. L. Feinberg (Lebedev Inst. of Physics, Moscow). Proc. Roy. Soc. (London), Ser. A, 278: 391-400(Apr. 7, 1964).

The advance of research on elementary particles using cosmic rays and accelerators and the future role of cosmic rays in this field are discussed. Some properties of strong interactions established in experiments with cosmic rays at $E > 10^{11}$ ev are discussed. 37 references. (R.E.U.)

20969 NUCLEAR INTERACTIONS FROM 30 TO 10^6 Gev. P. H. Fowler and D. H. Perkins (Univ. of Bristol, Eng.). Proc. Roy. Soc. (London), Ser. A, 278: 401-15 (Apr. 7, 1964).

The main features of high-energy inelastic nucleon-nucleon interactions are discussed. Cosmic particles are used for studies up to 10^6 Bev. Mean multiplicity, momentum distributions, elasticity, energy of secondaries, types

of secondaries, and the changing nature of the collisions at higher energies are discussed. (R.E.U.)

20970 PROGRESS IN OUR UNDERSTANDING OF ELEMENTARY PARTICLES. L. Van Hove (CERN, Geneva). Proc. Roy. Soc. (London), Ser. A, 278: 416-24 (Apr. 7, 1964).

The present understanding of the field of elementary particle physics is discussed historically. The roles of quantum field theory, symmetry principles, and selection rules are discussed. (R.E.U.)

20971 HIGH-ENERGY COLLISIONS OF STRONGLY INTERACTING PARTICLES. L. Van Hove (CERN, Geneva). Rev. Mod. Phys., 36: 655-65(Apr. 1964).

A phenomenological analysis of strongly interacting particle collisions above 5 Bev is performed. The approximate energy independence of elastic cross sections and the imaginary character of the scattering amplitude are investigated. A class of uncorrelated jet models is discussed, and their shadow scattering calculated and compared with experiment. The multiplicity and momentum-distribution near independence of energy is derived. (M.J.T.)

20972 NUCLEAR STRUCTURE AND FUNDAMENTAL PARTICLES. J. P. Sellschap (Witwatersrand Univ., S. Africa). S. African Ind. Chemist, 16: 202-12(Jan. 1962).

The nuclear shell model and its predictions are discussed. The buildup of the knowledge of fundamental particles and their symmetric relations is discussed. Properties of the particles are reviewed. (R.E.U.)

20973 ON THE INTERMEDIATE BOSON THEORY OF WEAK INTERACTION. Guo-zhen Yang and Hong Guan (Peking Univ.). Sci. Sinica (Peking), 13: 519-20(Mar. 1964).

The branching ratios for strange particle leptonic and nonleptonic decays were calculated on the basis of the Lee intermediate boson model. Decay of μ^-, π^-, Λ, Σ^-, and K_1^0 was considered. (C.E.S.)

20974 NEUTRAL K MESONS. I. I. Gurevich and B. A. Nikol'skii. Usp. Fiz. Nauk, 82: 177-99(Feb. 1964). (In Russian)

The neutral K mesons do not belong to the group of truly neutral particles; K^0 and its antiparticle $\widetilde{K}^0$ possess a strangeness S = +1 and S = −1, respectively. However, K^0 and $\widetilde{K}^0$ may decay according to $K^0 \to 2\pi$ and $\widetilde{K}^0 \to 2\pi$, making possible the transition $K^0 \rightleftharpoons 2\pi \rightleftharpoons \widetilde{K}^0$ through virtual meson states, including the special neutral meson state K, which occupies an intermediate position between the truly neutral particles, such as π^0 mesons and γ quanta and particles that differ from their antiparticles by a certain, strictly conserved quantum number, e.g., the electron and the positron. Because of their differing decay processes, the K_1^0 and K_2^0 mesons have different lifetimes: $\tau(K_1^0) = (1.00 \pm 0.04) \times 10^{-10}$ sec; $\tau(K_2^0) = (7.5^{+2.8}_{-1.6}) \times 10^{-8}$ sec. This difference in their lifetimes is responsible for the fact that at a sufficiently large distance from the point of generation of the neutral K mesons, the K_1^0 component is completely decayed and the beam consists only of K_2^0 mesons; however, after passage through matter, the K_1^0 mesons reappear. The wave properties and the lepton decay of the neutral K mesons are discussed, together with their isotopic properties. (Review article, 21 references). (TTT)

20975 EMPIRICAL REGULARITY IN EXCITED SYSTEM MASS DISTRIBUTION. A. Kh. Vinitskii. Vestn. Akad. Nauk Kaz. SSR, No. 5, 88-90(1963). (In Russian)

An attempt was made to systematize short-life nucleons and π-meson excitation states and to develop formulas that describe a definite regularity in their mass distributions. The mass of π-meson isobars decaying to "k" π-mesons is expressed by $M^*_{k\pi} = k\mu + k^n Q_\pi$ (when μ is the π meson mass, Q is a constant equal to 120 Mev, n = 0, 1, 2, 3...). The mass of nucleon isobars decaying to nucleons is described by a $M^*_{N_\pi} = \mu + M + 2^{n/2} Q_N$ (where M is the nucleon mass, Q_N is a constant equal to 155 Mev, and n = 0, 1, 2, 3...). Mass values calculated using the above formulas are tabulated and show agreement with experimental and theoretical mass values. The formulas predicting the mass values of unknown resonance systems but do not indicate formation probabilities for other systems. (R.V.J.)

20976 CALCULATION OF THE CHARGE RADIUS OF NUCLEONS BY USE OF A MODIFIED PROPAGATOR. Yung-jan Wang. Wu Li Hsueh Pao, 17: 57-60(Jan. 1961). (In Chinese)

20977 LOW-ENERGY πK-SCATTERING. Iring Bender and Volkhard F. Mueller (Universität, Heidelberg). Z. Physik, 176: 277-87(1963).

A self-consistent calculation of the s and p wave resonance in π-K scattering was attempted using as input the exchanged resonances themselves and the exchange of a ρ-meson. While this approximation to the left-hand cut failed in the s wave problem it produced a p wave resonance but for a much too strong ρ-coupling. Position and width depended very sensitively on the inelastic region. Suppressing this region by a subtraction at threshold the subtraction constant could be adjusted to yield the observed position. The corresponding width was close to the experimental values for reasonable ρ-coupling. (auth)

20978 FLUCTUATION PROBLEM IN ELECTROMAGNETIC CASCADES. [PART] II. S. K. Srinivasan, K. S. S. Iyer, and N. V. Koteswara Rao (Indian Inst. of Tech., Madras). Z. Physik, 177: 164-73(1964).

The fluctuation problem in electromagnetic cascades was examined in the light of the new approach to cascade theory. The moments of the number distribution of electrons produced in the entire shower (corresponding to infinite thickness) are obtained explicitly by a direct evaluation of inversion integrals. In particular, it is shown that the mean number of electrons that are produced in the shower for an energy greater than E is found to be proportional to E_0/E, while E_0 is the energy of the primary electron. In view of this result, it was found possible to evaluate the higher moments of the number distribution explicitly. (auth)

20979 POLARIZATION OPERATORS FOR s = 1. H. Hoegaasen (Norges Tekniske Hogskole, Trondheim, Norway). Z. Physik, 178: 123-6(1964).

Spin projection operators, useful in the relativistic Hamiltonian description of vector particles, are given. (auth)

20980 TWO-PARTICLE APPROXIMATION FOR FERMION SYSTEMS WITH PAIR CORRELATION. Herbert Wagner (Technische Hochschule, Munich). Z. Physik, 178: 146-58(1964).

Two-particle approximations for superfluid Fermion systems are discussed using the functional formalism of Brenig and Wagner (Z. Physik, 173: 484(1963)). A special symmetry of collective excitations is pointed out, which links density fluctuations to moving pairs excited from the pair condensate. It is indicated that the description of collective excitations in terms of T matrices automatically conserves this symmetry. A generalized ladder approximation was obtained, which is capable of treating collective excitations together with hard-core potentials. (auth)

20981 ON THE ALGEBRA OF CHARGE-LIKE QUALITIES. H. Baur (Rensselaer Polytechnic Inst., Troy, N. Y.). Z. Physik, 178: 390-408(1964). (In German)

According to the explanation, that under a charge-like quality, an effect on a system and a phase of a system should be understood, the exchange-effect possibilities between charged systems were investigated from the standpoint of pure combination. From that it was assumed that the exchange effect could be described with regard to the charge parameters by simple system combination. For assumption of the arithmetic additivity of the charge parameters for the atomic predicate of charged systems a special algebra was valid. The exchange effects between singly charged systems led in general to multiply charged system. The exchange effects correspond to unambiguous functions between the sets of states of the systems. Exchange-effect types with ambiguous functions also exist. They lead to production, annihilation, and transformation processes. It is indicated under what assumptions the derived combination scheme can serve for classification of elementary particles. (tr-auth)

20982 W-INDUCED ANOMALOUS MAGNETIC MOMENT OF LEPTONS, CALCULATED WITH ξ-LIMITING FORMALISM. H. Pietschmann (Universität, Vienna). Z. Physik, 178: 409-12(1964). (In German)

The influence on the anomalous magnetic moment of leptons of a charged intermediate vector boson, mediating weak interactions is discussed, using the ξ-limiting formalism. (auth)

20983 THE RENORMALIZATION GROUP METHOD AND HIGH-ENERGY SCATTERING. K. Huang and F. E. Lou (Massachusetts Inst. of Tech., Cambridge). Zh. Eksperim. i Teor. Fiz., 46: 845-50(Mar. 1964). (In Russian)

The renormalization group method is used to investigate the behavior of high-energy scattering amplitudes. It is shown that for pion-pion scattering, renormalizability imposes a restriction on the energy and coupling-constant dependence of the high-energy scattering amplitudes at a fixed angle. There is, however, no restriction on the angular dependence at fixed energy and coupling constant, or on the energy dependence at fixed momentum transfer. The method, therefore, is not relevant to the problem of Regge poles. It is further pointed out that the renormalization group method is not applicable to the problem of pion-nucleon scattering. These results are in disagreement with those of a number of authors. (auth)

20984 THEORY OF BREMSSTRAHLUNG AND PAIR PRODUCTION IN A MEDIUM. I. N. Toptygin (Leningrad Polytechnical Inst.). Zh. Eksperim. i Teor. Fiz., 46: 851-62(Mar. 1964). (In Russian)

Interaction between quanta and a medium during bremsstrahlung of ultrarelativistic electrons is investigated. It is shown that for sufficiently high energy electrons Compton scattering plays an important role in the soft part of the spectrum. The main contribution to the radiation in this case is from electrons of the medium emitting quanta in collisions with the fast particle. (auth)

20985 NONADIABATIC TRANSITIONS IN SLOW COLLISIONS BETWEEN HEAVY PARTICLES G. V. Dubrovskii (Leningrad State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 863-71(Mar. 1964). (In Russian)

The parametric method equations are solved in the adiabatic approximation by expanding the solution into a series in powers of the colliding particle velocities. The problem of transition probabilities in the presence of a frequency minimum is solved by asymptotic integration of the differential equation. A formula is derived that is an extension of familiar results of the pseudo-intersection theory but which does not possess its shortcomings. The method can be applied for investigating the effect of other features of the interaction and frequency on the magnitude of the cross section for various inelastic transitions in the adiabatic region. (auth)

20986 RESTRICTIONS IMPOSED ON THE $e^+ + e^- \rightarrow \pi^+ + \pi^-$ REACTION CROSS SECTION BY THE ANALYTICITY CONDITION. B. V. Geshkenbein and B. L. Ioffe. Zh. Eksperim. i Teor. Fiz., 46: 902-4(Mar. 1964). (In Russian)

Inequalities that set a lower limit for the $e^+ + e^- \rightarrow \pi^+ + \pi^-$ reaction cross section averaged over energy of the pair are obtained on basis of the analytic properties of the form factor $f(k^2)$ for the transition of a γ quantum into a $\pi^+ + \pi^-$ pair. (auth)

20987 ANALYTICAL PROPERTIES OF THE GREEN FUNCTION AND MASS OPERATOR. S. L. Ginzburg (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 905-12(Mar 1964). (In Russian)

The spectral representation of the mass operator of a system of interacting particles at a finite temperature is obtained. The case of a mass operator with a pole is considered. (auth)

20988 INTERACTION BETWEEN PARTICLES WITH SPINS AND REGGE POLES. M. S. Marinov. Zh. Eksperim. i Teor. Fiz., 46: 947-62(Mar. 1964). (In Russian)

The contribution of Regge poles with arbitrary quantum numbers to scattering of particles with spins is determined with aid of helicity amplitudes. The cross sections and polarization effects in πN and NN scattering are found. Production of mesons (ρ) and nucleon resonance are considered. The isotopic spin is taken into account. (auth)

20989 REGGE TRAJECTORIES IN THE BETHE-SALPETER EQUATIONS. Yu. A. Simonov. Zh. Eksperim. i Teor. Fiz., 46: 985-93(Mar. 1964). (In Russian)

An equation is derived that defines Regge trajectories for the sum of diagrams of the ladder type (particles of mass m exchange with particles of mass μ). The behavior of the trajectory l(s) as a function of s and of the coupling constant g^2 is investigated. An expansion of l(s) in a series in g^2 is obtained and it is shown that the sum of the senior terms in the asymptotic ladder diagrams yields the first two terms in the expansion, i.e. $l(s) = l_0 + g^2 l_1(s)$. The cause of this situation is ascertained. The equation for l(s) is solved exactly in the particular case for s = 0. The analytical form of $l(g^2)$ is presented for $\mu = 0$, and the results of numerical calculations for a number of values of μ^2/m^2 are given. (auth)

20990 ASYMPTOTIC VALUE FOR THE INTERACTION CROSS SECTION FOR TWO FERMI PARTICLES IN THE e^4-APPROXIMATION. V. G. Babak, V. K. Ignatovich, and E. S. Fradkin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1025-32(Mar. 1964). (In Russian)

The asymptotic value of the interaction cross sections (in the e^4-approximation) for two high-energy Fermi particles that is valid for all angles is obtained with double logarithmic accuracy. It is shown that for angles in the region of π the cross section $d\sigma_{e^-e^+}$ decreases. (auth)

20991 ON THE SYMMETRY OF THE CLEBSCH-GORDAN COEFFICIENTS. L. A. Shelepin (Lebedev Inst. of Physics, Moscow). Zh. Eksperim. i Teor. Fiz., 46: 1033-8(Mar. 1964). (In Russian)

Some consequences of the new symmetry of the Clebsch-Gordan coefficients derived by Regge are considered. All formulas in the theory of angular momentum are written in an invariant form (in R-symbols). As a result a number of new relations between the Clebsch-Gordan coefficients, Racah coefficients, and transformation matrices are obtained. In particular, Racah coefficients depending on the projections are considered. A graphic interpretation of Regge symmetry is presented. (auth)

20992 A FURTHER INVESTIGATION OF pp-PHASE SHIFTS AT 657 Mev. L. S. Azhgirei, N. P. Klepikov, Yu. P. Kumekin, M. G. Meshcheryakov, S. B. Nurushev, and G. D. Stoletov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1074-8(Mar. 1964). (In Russian)

The results of a phase shift analysis of pp scattering at 657 Mev are refined by taking into account new data on the angular dependence of the triple scattering parameter A. It is found that the experimental data under consideration can be reliably represented statistically by a set of the real parts of the phase shifts δ, mixing parameters ϵ and absorption coefficients r averaged over j. Arguments are presented that indicate that the phase shift set obtained is unique. (auth)

20993 THE RESONANT STATES OF ELEMENTARY PARTICLES. Proceedings of the First Anniversary Symposium, January 14 to 16, 1963. Matscience Report 1. Madras, The Institute of Mathematical Sciences, [1963]. 206p. Rs. 5-00; $1.00.

Separate abstracts are presented for 13 papers. One paper was previously abstracted for NSA; see abstract 17: 28185. (M.J.T.)

For abstracts of individual papers see: 20994, 20995, 20996, 20997, 20998, 20999, 21000, 21001, 21002, 21003, 21004, 21005, and 21006.

20994 SYMMETRIES AND RESONANCES. T. K. Radha. p.8-44 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

The need for higher symmetries incorporating the three known exact conservation laws for strong interactions is discussed. Charge conservation and charge independence are described in terms of unitary groups. Resonances as predicted by models built on SU_3 in the Sakata and octet theories are listed. Global symmetry and its models are discussed. Speculations, using Okubo's mass relation and Regge trajectories, are made. (M.J.T.)

20995 GROUP SYMMETRIES WITH R-INVARIANCE. R. E. Marshak. p.45-59 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Group symmetries, including R symmetry, are considered in terms of the Sakata model, within the framework of U_3, and the octet model, within the framework of SU_3. The electromagnetic consequences of these symmetries are discussed. The particle resonances are considered in relation to R invariance. (M.J.T.)

20996 REGGE POLES AND RESONANCES. T. K. Radha. p.60-81 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Potential scattering in the complex angular momentum plane is studied. Regge trajectories are given for baryons and mesons and their resonances. The trajectories of other poles are considered. The contributions of different Regge trajectories to high-energy cross sections are listed; ω, p', and ρ trajectories are discussed. Various theoretical developments are summarized. (M.J.T.)

20997 ON COMPOSITE PARTICLES AND REGGE POLES IN PERTURBATION THEORY AND IN ELECTROMAGNETIC AND WEAK INTERACTIONS. K. Raman. p.82-100 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Regge poles are discussed in terms of perturbation theory. Current-current interactions are covered. It is conjectured that there is a Regge trajectory characteristic of weak interactions. Conserved currents and composite models are discussed. (M.J.T.)

20998 DETERMINATION OF SPIN-PARITY OF RESONANCES. G. Ramachandran. p.101-7 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

The two principal methods that have been successfully used for the spin-parity determination, the Adair and the Dalitz methods, are described. (M.J.T.)

20999 G-PARITY AND ELECTROMAGNETIC EFFECTS IN THE RESONANCES. K. Raman. p.108-23 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

The role of G parity in determining resonance properties is discussed. A survey is made of electromagnetic effects related to resonances: mixing effects and isospin violation; radiative and non-radiative decays; isomultiplet mass differences; form factors and electromagnetic moments; photoprocesses, especially bremsstrahlung. (M.J.T.)

21000 THE SINGLE-PARTICLE EXCHANGE MODEL AND THE RESONANCES. K. Raman. p.124-34 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

The one-particle-exchange (OPE) model is discussed. The regions where it is a good approximation are sketched. The properties of the OPE model and their relation to the spin and mass of the exchange particle and to the elasticity of the vertices are described. Tests of the model are outlined. Causes for deviation are stated, and generalizations in relation to the resonances are mentioned. (M.J.T.)

21001 PION RESONANCES. T. S. Santhanam. p.135-50 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Theoretical indications for a meson strongly coupled with the nucleon—the ω meson—are reviewed. Various experimentally found $\pi-\pi$ resonances are discussed. Methods of quantum number determination are described. Attempts to calculate the mass and coupling constant of the ρ meson are explained. Effects of the 2π-resonance potential on a 3π system are calculated. (M.J.T.)

21002 QUANTIZATION OF A SELF-COUPLED BOSON FIELD. R. K. Umerjee. p.151-6 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

A method using dispersion theory, to account for the multi-pion resonances in terms of a self-coupled pion field, without introducing π-N collisions, is outlined. The case for a neutral, zero spin boson field is worked out. (M.J.T.)

21003 K-MESON-PION RESONANCES. K. Raman. p.157-77 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Reasons for hypothesizing a K* vector meson for the K-π resonance are cited. Possible methods for determining the spin of K* are described. The positions of K* and other mesons in various symmetry schemes are discussed. Two pictures of the dynamics of (Kπ) systems are given: (1) π and K are the basic building bricks; (2) π and K are bound states of baryon-antibaryon systems. The consequences of assuming K and K* are on Regge trajectories are investigated. (M.J.T.)

21004 PION-NUCLEON RESONANCES. K. Venkatesan. p.178-88 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Experimentally known π-N resonances and their properties are listed. The mechanism of these resonances and proposed theories are studied. (M.J.T.)

21005 PION-NUCLEON RESONANCES AND THEIR ROLE IN SCATTERINGS AND PRODUCTION PROCESSES. K. Venkatesan. p.194-7 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

A procedure giving the contribution of the 3-particle channels to the 2-particle amplitude is presented, for reactions such as $\pi + N \rightarrow \pi + \pi + N$ and $\pi + \pi + N \rightarrow \pi + \pi + N$. (M.J.T.)

21006 PION-HYPERON RESONANCES. R. K. Umerjee. p.198-206 of "The Resonant States of Elementary Particles." Madras, The Institute of Mathematical Sciences, 1963.

Hyperon isobars with B = 1, S = −1 (Y_1^*, Y_0^*, Y_0^{**}, Y_0^{***}, Y_2^*) are listed, and their production is discussed. Difficulties in the determination of spin-parity for these resonances are analyzed. Possible interpretations of the resonances are reviewed. (M.J.T.)

21007 THEORETICAL CALCULATIONS OF THE $K_1^0 - K_2^0$ AND $\pi^+ - \pi^0$ MESON MASS DIFFERENCES. Vernon Duane Barger. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 43p.

An expression for any mass difference, exact in all strong interactions and of second order in weak interactions, is obtained directly from perturbation theory. To account for the $K_1^0 - K_2^0$ mass difference, a direct $K_1^0 - 2\pi$ interaction is introduced which gives $\tau(K_1^0)$ $[m(K_1^0) - m(K_2^0)]$ in terms of the I = 0, s-wave pion-pion scattering phase shifts. Possible generalizations of this model of the $K_1^0 - K_2^0$ mass difference are discussed. An expression for the electromagnetic self-energy to first order in the fine-structure constant, including all nonelectromagnetic interactions without approximation, is derived in terms of a Compton-scattering amplitude. The generalized form factors of this amplitude are evaluated for the $\pi^+ - \pi^0$ mass difference by dispersion-theoretic techniques. Using the general physical principles of crossing symmetry, Lorentz invariance, and gauge invariance, we obtained the result given by Riazuddin [Phys. Rev., 114: 1184(1959)]. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21008 POLARIZATION OF PROTONS ELASTICALLY SCATTERED FROM DEUTERONS. Robert Anton Chalmers. Thesis, Evanston, Ill., Northwestern Univ., 1963. 69p.

The polarization of protons elastically scattered from deuterons was measured by a double-scattering experiment. The proton beam of an electrostatic accelerator was scattered first in C at 4.1 Mev to produce a polarization of −28%. Degrading foils were used to produce energies of 1.50, 2.02, and 2.52 Mev at the second scattering in a gas-filled chamber. The use of a mixture of D, He, and Xe in this chamber, and semi-conductor detectors (in which protons elastically scattered from the different gases were resolved) permitted a direct comparison of the p-D polarization with the p-He polarization and allowed the simultaneous monitoring of instrumental asymmetries. Measurements were made at 45°, 65°, and 85° (in the center of mass) at 1.50 Mev, and at 45°, 65°, 85°, 100°, and 120° at the other two energies. Maximum polarizations of $+0.08 \pm 0.02$ were found at 85°, lesser values at 65° and 100°, and near zero values at 45° and 120°. No apparent energy dependence was found. The results are consistent in all respects with recent neutron-deuteron polarization experiments of comparable precision. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21009 PART I: A STUDY OF LOW-ENERGY $\pi-\Lambda$ SCATTERING. PART II: THE CHEW ANALYSIS APPLIED TO LOW ENERGY $\pi-\Lambda$ SCATTERING. PART III: ON THE REGGE REPRESENTATION FOR THE NUCLEON ELECTRO-MAGNETIC FORM FACTORS. Michael Der-Sarkissian. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 57p.

In Part I, an attempt is made to study low energy p-wave $\pi-\Lambda$ scattering within the S-matrix framework. By neglecting multi-channel effects (as a first approximation) and taking account of the short range forces using the Balázs effective range formalism, the main features of low energy p-wave $\pi-\Lambda$ scattering are found. The deviation from a completely self-consistent calculation is probably an indication of the importance of multi-channel effects. Using the results of this calculation, a method suggested by Chew is applied to low energy $\pi-\Lambda$ scattering in order to relate the residues of the true Σ and true Y_1^* poles. The numerical relation found is in rough agreement with the numbers used in Part I and with experimental information now available for these residues. In Part III, the Balázs effective range formalism is used to study the Regge representation for the nucleon electromagnetic form factors. The ρ and ω trajectories that are a consequence of this representation lead to $m_\rho \approx 18$ p.m.u. and $m_\omega \approx 25$ p.m.u., in rough agreement with experimental data. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21010 RADIATIVE CORRECTIONS TO MUON AND BETA DECAY MEDIATED BY A VECTOR BOSON. Gerald Dorman. Thesis, New York, New York Univ., 1963. 120p.

Radiative corrections to the spectrum and rate of muon and β decay mediated by a vector boson were calculated to order α, as functions of the mass, M, and the anomalous magnetic moment, μ, of the boson. The renormalizable theory of the electrodynamics of vector particles given by Z. Bialynicki-Birula was used. The corrections to both muon and β-decay were found to depend logarithmically upon an ultraviolet cutoff, Λ. However, in both decays, when $\mu = -1.95$ the dependence upon the cutoff is negligible for finite values of Λ. In taking the ratio of the rates of the two decays, the main contribution of $\ln \Lambda$, for arbitrary μ, cancels and the theoretical prediction for τ_μ is found to be almost completely insensitive to Λ. The results are in approximate agreement with universality and the conserved vector hypothesis if $M_K < M < m_p$. The actual values of M necessary for agreement depend very slightly on Λ and rather slowly on μ. For $-3 < \mu < 2$ it is found that a value of $M = 605 \pm 25$ Mev would result in agreement independent of the actual value of μ. This value of M is also found to give agreement between the theoretical and experimental muon spectrum, independent of the values of μ and Λ. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21011 DIFFERENTIAL DISTRIBUTIONS OF NEUTRONS IN INELASTIC $\pi^- - p$ INTERACTIONS AT 374, 417, AND 454 Mev. Richard John Kurz. Thesis, Berkeley, Calif., Univ. of California, 1963. 144p.

The inelastic interactions of π^- mesons with protons at 374, 417, and 454 Mev incident π kinetic energy were studied by measuring the differential distributions of final-state neutrons. The π source was an internal target of the Berkeley 184-in. synchrocyclotron. The time-of-flight distribution of neutral particles was measured at various laboratory-system angles between 10 and 65°. Neutral particles were detected by observing the charged products of their interactions in plastic scintillator. Analysis, presuming the principal inelastic reactions to be $\pi^- p \rightarrow \pi^+ \pi^- n$ and $\pi^- p \rightarrow \pi^0 \pi^0 n$, separated the time-of-flight spectra into γ rays, neutrons from the reaction $\pi^- p \rightarrow \pi^0 n$, and inelastic neutrons. Calculated values of the neutron-detection efficiency were used in the conversion of the neutron time-of-flight distribution to neutron differential distributions as a function of energy. A definite deviation from the behavior expected on the basis of a statistical distribution or a simple peripheral collision model was observed in the distributions of the inelastic neutrons. The differential distributions showed a strong preference for neutrons of low c.m. momentum. By integrating the differential distributions, the total cross sections for the two inelastic reactions were obtained. The cross section for the $\pi^+ \pi^- n$ channel was a rapidly rising function of incident π energy, whereas the cross section for the $\pi^0 \pi^0 n$ channel was essentially constant as a function of energy. The total cross section for the processes $\pi^- p \rightarrow$ neutrals was obtained along with tentative data on the angular distribution of the reaction $\pi^- p \rightarrow \pi^0 n$. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21012 THE $|\Delta T| = \frac{1}{2}$ RULE IN $K^+ \rightarrow \pi^+ + \pi^0$ DECAY. Hans Morawitz. Thesis, Stanford, Calif., Stanford Univ., 1963. 95p.

A specific model is constructed to calculate the $K^+ \rightarrow \pi^+ + \pi^0$ decay to second order in e. Radiative corrections are assumed to account for the observed decay rate $\omega(K^+ \rightarrow \pi^+ + \pi^0) = 2.1 \times 10^{+7}$, the process being forbidden by the $|\Delta T| = \frac{1}{2}$ rule in the absence of electromagnetic interaction. The model brings about the K^+ decay by a combination of a strong $\bar{K}K\pi\pi$ vertex and a weak $K\pi\pi$ vertex. The coupling constants are taken from low energy $K-\pi$ charge exchange scattering for the strong vertex and K_1^0 decay for the weak vertex. The $\pi^+ - \pi^0$ mass-difference is used as a first estimate of electromagnetic effects, and the decay rate is calculated. The result diverges logarithmically, and unreasonably high values for the cut-off are required to give agreement with experiment. A different model with an intermediate ρ meson is also used, leading to a similar result for the effect of finite $\pi^+ - \pi^0$ mass-difference. The radiative decay $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$ is calculated in the simpler model, and the ratio $(K^+ \rightarrow \pi^+ + \pi^0 + \gamma)/(K^+ \rightarrow \pi^+ + \pi^0)$ was found to be 2.2×10^{-6}, which is 2 orders of magnitude smaller than the internal Bremsstrahlung rate. Second-order radiative corrections to the $K^+ \rightarrow \pi^+ + \pi^0$ decay are calculated by assuming an unsubtracted dispersion relation to hold for the decay amplitude. The dominant contribution to the dispersion integral comes from the $\pi-\gamma$ intermediate state, and the magnitude of the cut off required to give agreement with experiment is ~1 Bev. It is concluded that the size of the cut-off is related to nucleon-hyperon effects on the strong vertex. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21013 POLARIZATION AND ANGULAR DISTRIBUTION OF BREMSSTRAHLUNG OF RELATIVISTIC ELECTRONS NEAR THE ENERGY LIMIT. J. Seyerlein. Thesis, Würzburg, Ger., Universität, 1963. 35p. $2.00(Gmelin, AED-DISS. 63-308). (In German)

An apparatus for the measurement of polarization and angular distribution of bremsstrahlung from a 32-Mev betatron is described. Results indicate that the polarization degree at the energy limit has a small but still positive value. The measured values are in fair agreement with theoretical results. (Gmelin Inst.)

21014 APPLICATION OF QUANTUM ELECTRODYNAMICS FOR ELECTRON-NUCLEON PROCESSES. W. Sandhas. Thesis, Berlin, Universität, 1963. 57p. $2.00(Gmelin, AED-DISS. 63-289). (In German)

Applications of quantum electrodynamics for electron, photon, nucleon, and pion processes are studied. Expressions from the theory of strong interactions are deduced so that the interaction of the electron-photon field, which can be described by quantum electrodynamics, is separated from the other fields. Electron-nucleon scattering is considered in detail. (Gmelin Inst.)

21015 EXPERIMENTAL STUDY OF THE BRANCHING RATIOS OF THE DECAY MODES $\Sigma^\pm \rightarrow n + e^\pm + \nu$. Charles Thornton Murphy. Thesis, Madison, Wisc., Univ. of Wisconsin, 1964. 57p.

A search was made for examples of the beta decay mode of the sigma hyperon, $\Sigma^\pm \rightarrow n + e^\pm + \nu$, among a large sample of sigmas produced by stopped K^- mesons in a propane-freon filled bubble chamber. A total of 23000 negatively charged sigmas and 17000 positively charged sigmas were observed that decayed via the charged π mode, $\Sigma^\pm \rightarrow n + \pi^\pm$. An electron track was distinguished from that of a π meson by the observation that the track curled up in the chamber, or curved too much, or produced a δ ray with too high an energy to have been produced by a π from a sigma decay. No Σ^+ beta decays, which are thought to be forbidden by the $\Delta S = \Delta Q$ rule, were found. A total of 11 Σ^- beta decays were found. A study of backgrounds indicated that only one or two of these events were probably spurious. The detection efficiency of the chamber for electrons was 55%. The branching ratio for Σ^- beta decay, $(\Sigma^- \rightarrow n + e^- + \nu)/(\Sigma^- \rightarrow n + \pi^-)$, was found to be $(0.9^{+0.4}_{-0.3}) \times 10^{-3}$. The detection efficiency of the chamber for positrons from acceptable Σ^+ beta decays was much lower than the efficiency for Σ^- beta decays. The upper limit of the ratio of the Σ^+ beta decay rate to the Σ^- beta decay rate, $(\Sigma^+ \rightarrow n + e^+ + \nu)/(\Sigma^- \rightarrow n + e^- + \nu)$, determined in this experiment is 0.3. (Dissertation Abstr., 24: No. 9, March 1964)

21016 MOTION OF POLES AS A BROKEN RESONANCE MULTIPLET APPROACHES DEGENERACY. Robert L. Warnock (Illinois Inst. of Tech., Chicago). 6p. (CONF-481-9)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The matrix ND^{-1} representation is used in considering the T = 1, Y = 0 channel of meson-baryon scattering that involves the states $\pi\Lambda$, $\pi\Sigma$, $\bar{K}N$, $\eta\Sigma$, and $K\Xi$. The motion of the Y_1^* pole in the approach to degeneracy is investigated. (C.E.S.)

21017 ω-ρ INTERFERENCE. W. D. Walker, J. Boyd, A. R. Erwin, P. H. Satterblom, M. A. Thompson, and E. West (Univ. of Wisconsin, Madison). 12p. (CONF-481-11)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Mesons (ω) and (ρ) interference effects in the π^+-π^- mass

spectra of the π^--p interaction at 2.1 Bev/c in a hydrogen bubble chamber are discussed. (C.E.S.)

21018 τ^+ ANALYSIS. T. Huetter, E. L. Koller, S. Taylor, P. Stamer, and J. Grauman (Stevens Inst. of Tech., Hoboken, N. J.). 8p. (CONF-481-16)

From American Physical Society Annual Meeting, New York, Jan. 1964.

An analysis of approximately 1000 $\tau^+ \rightarrow \pi^+ + \pi^+ + \pi^-$ events is presented. These events were found in an area scanning of an emulsion stack of 600-μ Ilford G5 pellicles exposed to a 300-Mev/c separated K^+ beam. The energy spectra of the pions are compared to existing spectra of the secondaries from η, τ^1, and τ'. (auth)

21019 THEORY OF H^3 AND He^3 FORM FACTORS. L. I. Schiff (Stanford Univ., Calif.). 39p. (CONF-481-19)

From American Physical Society Annual Meeting, New York, Jan. 1964.

A theoretical background is provided for recent experiments on the elastic scattering of high-energy electrons from ^{3}H and ^{3}He. Formulas are derived on the basis of the isotopic spin formalism that relate the observed electric charge and magnetic moment form factors for the two nuclei to the charge and moment form factors of the proton and neutron, two form factors that describe the spatial distributions of the centers of the like pair of nucleons and the odd nucleon (body form factors), and an exchange magnetic moment form factor that is to be determined empirically. The body form factors are then calculated analytically for three assumptions as to the dependence of the wave function on the internucleon distances. Two parameters appear in the calculations with each wave function: a size parameter, and the amplitude of the mixed-symmetry S state that, together with the dominant fully space-symmetric S state, forms the nuclear ground state. The sign of this amplitude predicted on the basis of the known spin-dependent two-nucleon interaction is found to agree with the electron scattering experiments, and its magnitude is reasonable. The available experimental data show a definite preference for the Gaussian and Irving forms of wave function over a modified exponential form, and a slight preference for the Irving over the Gaussian form. The size parameters obtained for these two wave functions are in good agreement with those obtained from the Coulomb energy of ^{3}He, and the probability of the mixed-symmetry S state is found to be about 4 percent. (auth)

21020 S-WAVE $\bar{K}$-NUCLEON INTERACTIONS. Ramesh Chand (Syracuse Univ., N. Y.). 52p. (CONF-481-25)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The low energy K^--proton and K^--deuteron scattering and absorption processes are described in terms of six new sets of s-wave energy-dependent $\bar{K}$-nucleon interaction parameters solutions, called, X1, X2, Y1, Y2, Z1, and Z2, obtained by reasonable interpolations between Watson's amplitudes of solution A to represent s-wave $\bar{K}N$ phenomena in both the I = 0 and I = 1 channels at K^--laboratory momentum k_L = 400 Mev/c; Ross and Humphrey's amplitudes of solution II describing the I = 1, $\bar{K}N$ scattering at k_L = 0 and 100 Mev/c; and by requiring the 1405-Mev Y_0^*-resonance as an s-wave bound state of $\bar{K}N$ system. The K^--p and K^--d scattering (both elastic and inelastic) processes are found to be rather insensitive to the width of Y_0^*-resonance. The comparison between the experimental and the calculated values of the Σ and Λ production cross sections in both the K^--p and K^--d collisions shows that most probably the correct width of Y_0^* is 1 Mev. (auth)

21021 THREE PION DECAY MODES OF ETA AND K-MESONS AND A POSSIBLE NEW RESONANCE. Laurie M. Brown and Paul Singer (Northwestern Univ., Evanston, Ill.). 20p. (CONF-417-25)

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

A model, which postulates a spin zero T = 0 dipion, proposed earlier to explain an apparent enhancement of the three pion decay mode of the meson (η), is applied to obtain detailed predictions concerning the three pion decays of the mesons (η) and (K). Good agreement is found with all the available data on η and K spectra and branching ratios if the dipion mass and full width are taken as about 400 Mev and 75 to 100 Mev respectively, thus providing positive evidence for the existence of a two pion resonance. (auth)

21022 RAY-TRACING METHOD FOR ION-OPTICAL MEASUREMENTS. Eligius A. Wolicki and Philip R. Malmberg. U. S. Patent 3,131,299. Apr. 28, 1964. Filed Dec. 29, 1961.

A method and an apparatus are described for accurately measuring the trajectories of moving charged particles over large divergencies of ion paths and thus measuring the focal properties of electric or magnetic lens systems with large acceptance or output solid angle. The apparatus comprises a slit box and a graduated quartz (fluorescent) plate secured together and adapted to be connected to the output of a focusing system. The operation of the device is described. (D.L.C.)

Field Theory and Quantum Mechanics

Refer also to abstract 20991.

21023 (NP-13878) THE FORMULATION OF THE DYNAMICAL LAWS IN THE QUANTUM THEORY OF FIELDS. Lecture Given by P. Kristensen at Universitetets Institut for Teoretisk Fysik and NORDITA Copenhagen. (Nordisk Institut for Teoretisk Atomfysik, Copenhagen). 1962. 109p.

The kinematics, weak quantization of the Schwinger group, and equations for the vertex functions are discussed in scalar meson field theory. The weak coupling limit and the limit of $\hbar \rightarrow 0$ for the vertex functions are discussed. Some properties of the two-point vertex function and the Hurst-Thirring field are discussed. A lemma on Hilbert transforms is presented. (R.E.U.)

21024 SINGULAR RESOLUTIONS IN SPINOR FIELD THEORY AND CLASSES OF FERMIONS. L. E. Lebedev (Dniepropetrovsk State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 39-48(1964). (In Russian)

A field model of elementary particles is considered. A class of weakly singular spinors is determined. A new representation of fermions in field systems is discussed. A variational method employing trial functions is used to investigate the classes of the system. The characteristics of the baryon, muon, and electron classes of fermions are determined. A conservation law for baryon and lepton charge is proposed, and an experiment for verification of this law is suggested. (tr-auth)

21025 ON THE GREEN FUNCTION FOR SCATTERING IN A REGION WITH A POTENTIAL BARRIER. N. B. Aizenberg (Tashkent State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 1, 153-9(1964). (In Russian)

The problem of stationary scattering is discussed using the Schroedinger equation for a region containing the scattering potential and a potential barrier. The potential barrier is expressed in Cartesian coordinates. The Green function is determined for this problem, and it is shown that its asymptotic expression contains the solution of the Schroedinger equation for an unperturbed barrier for an accurate choice of scattering direction. The absence of glancing scattering along the barrier was established by means of the Green function, and the basis of a perturbation method for the scattering problem is given. Other approximations for this problem are discussed. (tr-auth)

21026 INTENSIVE OBSERVABLES IN QUANTUM THEORY. R. F. Streater (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 5: 581-90(May 1964).

The notion of strictly intensive observables is introduced in a theory of local observables (such as that of R. Haag). If O_1, O_2 are two disjoint regions, then the value of a strictly intensive observable in $O_1 \cup O_2$ is the sum of its values in O_1 and O_2. It is shown that energy-momentum can never be strictly intensive. This result is used to prove that the algebras of observables is not of Type I for some regions. By analogy with the energy-momentum tensor density for the free field, the definition is weakened, so that an intensive observable in a region O is only "approximately" in $\mathcal{A}(O)$. This leads to the introduction of germs of intensive observables. It is proved that the unitary intensive operators form a sheaf F of groups, and the Hermitian intensive operators form a sheaf G of Abelian groups with operators in F, and on which the inner derivative $Y \rightarrow i(XY - YX)$ is defined. (auth)

21027 COULOMB GREEN'S FUNCTIONS AND THE FURRY APPROXIMATION. Levere Hostler (Stanford Univ., Calif.). J. Math. Phys. (N. Y.), 5: 591-611(May 1964).

The Coulomb Green's function for the nonrelativistic Schrödinger equation is obtained in closed form, starting from the partial-wave expansion and using an integral representation for a product of two Whittaker functions with different arguments. The Neumann's series for $J_\nu(kz)$ is required in evaluating the sum on states. The Coulomb Green's functions for the Klein-Gordon and iterated Dirac equations are obtained in closed form in the "Furry approximation," $a^2/(J + \frac{1}{2})^2 \ll 1$, $a = Ze^2/4\pi\hbar c$. The Klein-Gordon Green's function in this approximation is shown to be at the same time the exact Green's function for the Klein-Gordon equation without the potential squared term. An alternate and very simple derivation of the approximate Green's function for the iterated Dirac equation is given using perturbation theory. From this Green's function, an approximate Coulomb Green's function in closed form for the Dirac equation itself is constructed. Certain known results for Coulomb wavefunctions with modified plane-wave behavior at large distances are rederived using the foregoing methods and results. (auth)

21028 APPLICATION OF NONLOCAL FIELD OPERATORS TO A SYSTEM OF HARD-SPHERE BOSE GAS. K. W. Wong (State Univ. of Iowa, Iowa City). J. Math. Phys. (N. Y.), 5: 637-42(May 1964).

Some relationships of the nonlocal field operators developed by Siegert et al. and the usual free-field operators are obtained. The interaction Hamiltonian derived with the help of these relationships is compared with the pseudopotential recently obtained by Liu and Wong. A study of the fluid dynamical equations at extreme low temperature has been made. (auth)

21029 ANALYTIC SOLUTION OF THE PERCUS-YEVICK EQUATION. M. S. Wertheim (New York Univ., New York). J. Math. Phys. (N. Y.), 5: 643-51(May 1964).

The properties of the Percus-Yevick approximate integral equation for the pair distribution function in classical statistical mechanics are examined for the class of pair potentials consisting of a hard core plus a short-range tail. For one-dimensional systems, some elementary theorems of complex variable applied to the Laplace-transformed equations enable the direct correlation function to be expressed in a very simple form, one which becomes explicit and trivial in the absence of a short-range tail. In the presence of the tail, the direct correlation function satisfies a (coupled) integral equation over a finite domain. The impossibility of a phase transition in one dimension is strongly indicated. Analysis of the case of three dimensions proceeds similarly, but is complicated by the appearance of essential parameters other than the density and compressibility. The character of the direct correlation function is qualitatively unchanged. Principal differences in three dimensions are that a phase transition is no longer prohibited, and the pair distribution function can not be reasonably expressed as a sum of nth-neighbor contributions. (auth)

21030 THE INFLUENCE OF INITIAL CORRELATIONS ON THE APPROACH TO EQUILIBRIUM. Gerald L. Jones (State Univ. of Iowa, Iowa City). J. Math. Phys. (N. Y.), 5: 651-8(May 1964).

The irreversible behavior of a particle under the influence of fixed scattering centers is investigated in the weak coupling limit. An ensemble is introduced which statistically describes the scattering centers as well as the particle. This allows the treatment of correlations between the particle and the scattering centers. A new diagrammatic method is used to investigate high-order terms in the perturbation theory. This method yields quite explicit information about the way in which the influence of initial correlations will disappear. In particular, it is quite clear that as one goes to higher order in the perturbation theory one must wait longer times for the influence of initial correlations to disappear. For completeness, the Boltzmann equation is derived and solved to lowest order in the interaction strength. (auth)

21031 PHASE-SPACE FORMULATION OF THE DYNAMICS OF CANONICAL VARIABLES. C. L. Mehta (Univ. of Rochester, N. Y.). J. Math. Phys. (N. Y.), 5: 677-86(May 1964).

Statistical reformulation of quantum mechanics in terms of phase-space distribution functions as given by Moyal using Weyl's correspondence rule between classical functions and operators were extended to various different correspondence rules. The dynamical bracket in theWeyl correspondence (the "Moyal" or the "sine" bracket) is shown to be a Lie bracket. It is further shown that if the theory is restricted to Lie brackets of the form $[u(p,q), v(p,q)] = \{f(\partial^2/\partial q_1 \partial q_2 - \partial^2/\partial q_2 \partial q_1)u(p_1,q_1)v(p_2,q_2)\}$, evaluated for $p_1 = p_2 = p$, $q_1 = q_2 = q$ after differentiation, then the only admissible functional form of f is $f(x) = \beta[(\sin \alpha x)/\alpha]$, where α and β are constants. A law of multiplication which is associative and distributive with respect to addition is also introduced in each case. It gives a correct correspondence between operator multiplication and the multiplication of classical functions. The dynamical brackets obtained in each case are also found to be Lie brackets. Conditions on the phase-space distribution functions to describe pure states are also given. (auth)

21032 NORM INVARIANCE OF MASS-ZERO EQUATIONS UNDER THE CONFORMAL GROUP. Leonard Gross (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.), 5: 687-95(May 1964).

It is known that a suitable collection of solutions of the free-field Maxwell's equations is a Hilbert space with respect to an appropriate norm, and that the inhomogeneous Lorentz group acts on this Hilbert space in a unitary and irreducible manner. It is shown that this representation extends to a unitary representation of the conformal group of Minkowski space. Similar results are obtained for other mass-zero relativistic equations. (auth)

21033 EXISTENCE OF A NEW CONSERVATION LAW IN ELECTROMAGNETIC THEORY. Daniel M. Lipkin (American Electronic Labs., Inc., Colmar, Penna.). J. Math. Phys. (N. Y.), 5: 696-?(May 1964).

Ten new extensive quantities that appear to be independent of stress-energy, but that analogously characterize the physical state of an electromagnetic field, are exhibited, and are shown to be conserved in vacuum because of Maxwell's equations. These new quantities are shown to be capable of retrograde flow in a circularly polarized plane-wave field. (auth)

21034 EXACT EIGENSTATES OF THE PAIRING-FORCE HAMILTONIAN. R. W. Richardson and N. Sherman (Univ. of Michigan, Ann Arbor). Nucl. Phys., 52: 221-38 (Mar. 1964).

The problem of determining the eigenstates of the pairing-force Hamiltonian is reformulated in terms of the eigenstates of a many-boson system with an N-body interaction. The N-body interaction includes the effects of the Pauli principle on the eigenstates of the pairing-force Hamiltonian. Explicit expressions for four types of eigenstates are derived. These four types are the eigenstates of N pairs in one or two multiply degenerate single-particle levels, the one-pair eigenstates, and a new restricted class of N-pair eigenstates. (auth)

21035 SPECTRAL REPRESENTATION IN POTENTIAL SCATTERING. E. Galzenati (Università, Naples and Istituto Nazionale di Fisica Nucleare, Naples). Nuovo Cimento (10), 31: 1197-1208(Mar. 16, 1964).

Potential scattering in momentum space is analyzed in an approach that makes use of a spectral representation for the wave function. It is shown that solutions for scattering as well as for bound states can be obtained from the solutions of integral equations of the Volterra type. The procedure is discussed in detail and is compared with similar methods that were developed for configuration space. (auth)

21036 ON THE BEHAVIOR OF THE PARTIAL-WAVE AMPLITUDES FOR LARGE ANGULAR MOMENTA IN POTENTIAL SCATTERING. A. Martin (CERN, Geneva). Nuovo Cimento (10), 31: 1229-45(Mar. 16, 1964).

A method is presented for studying the behavior of the S matrix for large-amplitude complex angular momenta. The method consists in showing that if the integral form of the Schroedinger equation is integrated along a judiciously chosen complex path, one is able to limit the inhomogeneous term and the kernel of the integral equation to simple expressions (separable in the case of the kernel), which lead to limitations on the solution and on the S matrix. This is carried out for a real angular momentum and for an angular momentum whose real part is equal to $-\frac{1}{2}$. The results can be extended to any point in the complex half-space. (tr-auth)

21037 SOME RIGOROUS ANALYTICITY PROPERTIES OF THE FOUR-POINT FUNCTION IN MOMENTUM SPACE. J. Bros, H. Epstein, and V. Glaser (CERN, Geneva). Nuovo Cimento (10, 31: 1265-1302(Mar. 16, 1964).

Geometrical methods of analytic completion are used to enlarge the primitive domain of analyticity of the four-point function in p-space. The results imply, in particular, analyticity of the scattering amplitude in two variables, on the mass shell, near all physical points, as well as analyticity of partial-wave amplitudes in s near the physical points of the right-hand side cut. (auth)

21038 VERTEX RENORMALIZATION IN POTENTIAL THEORY. L. Bertocchi (Università, Bologna and Istituto Nazionale di Fisica Nuclear, Bologna). M. McMillan, E. Predazzi, and M. Tonin. Nuovo Cimento (10), 31: 1352-63(Mar. 16, 1964).

Two methods for studying the properties of the vertex renormalization constant in potential theory are analyzed in connection with the problem of bound states. (auth)

21039 RELATIVISTIC MODEL FIELD THEORY. Allan S. Krass (State Univ. of Iowa, Iowa City). Phys. Rev., 134: B605-11(May 11, 1964).

A relativistic generalization of the Lee model is constructed and solved in the first sector. The solubility is achieved with an indefinite metric and a redefinition of antiparticle operators, which amounts to a selection rule prohibiting pair creation. The renormalization of the V-particle results in three dressed states, one of which is a ghost. The properties of these states and their dependence on cutoff and coupling strength are discussed. The effects of various modifications of the interaction are analyzed. The N-θ scattering problem is solved exactly. (auth)

21040 WATSON-SOMMERFELD TRANSFORMATION FOR MANY-PARTICLE SCATTERING AMPLITUDES. James B. Hartle (California Inst. of Tech., Pasadena). Phys. Rev., 134: B612-19(May 11, 1964).

The continuation of many-particle partial-wave scattering amplitudes to complex values of the total angular momentum is discussed in the framework of potential scattering. It is shown that if there is a continuation for which a Watson-Sommerfeld transformation of the full scattering amplitude can be made, then it is unique and determines the behavior of the amplitude for large values of any single scattering angle. The continuation of the partial-wave Schrödinger equation to complex values of the angular momentum is discussed, and the results are generalized to the case when exchange forces are present. As a simple application of the results, a crude nuclear model is discussed to illustrate how sequences of rotational levels can be described by Regge trajectories. (auth)

21041 COMPLEX ANGULAR MOMENTUM IN THREE-PARTICLE POTENTIAL SCATTERING. James B. Hartle (California Inst. of Tech., Pasadena). Phys. Rev., 134: B620-9(May 11, 1964).

The continuation of a class of three-particle potential scattering amplitudes to complex values of the total angular momentum is described. The class of amplitudes considered are those that describe a scattering in which a given pair of the particles is bound in the initial and final states. A nonrigorous discussion indicates that, except for simple kinematic factors, the only singularities present in the complex angular momentum plane are dynamical poles and possible isolated essential singularities. The Watson-Sommerfeld transformation of the full amplitude can be performed to display its large momentum-transfer behavior. (auth)

21042 HITHERTO OVERLOOKED SU_3 OCTET OF REGGE POLES IMPLIED BY BOOTSTRAP DYNAMICS. Alberto Pignotti (Univ. of California, Berkeley). Phys. Rev., 134: B630-2(May 11, 1964). (UCRL-11152)

The scattering of two pseudoscalar mesons belonging to the octet representation of SU_3 is studied in the framework of bootstrap dynamics. It is found that the leading Regge poles correspond to a singlet and two octet SU_3 representations. The singlet state is unambiguously identified with the Pomeranchuk trajectory, and one of the octets corresponds to the well-known vector mesons. The other octet is composed of even-signature poles which are called P′, Q, and R, and which, in a first approximation, coincide in position with the vector-meson trajectories. These poles are not likely to manifest themselves as low-mass particles or resonances because of their positive signature, but they are expected to influence appreciably high-energy scattering in the crossed channel. In particular, the P′ pole plays the role of the second vacuum trajectory proposed by Igi, and the R is suitable to explain, through an interference with the ρ role, the sign, value, and high-energy dependence of the difference between total pp and np cross sections. (auth)

21043 STRONG SHRINKAGE OF THE EFFECTIVE CORE AT HIGH ENERGY. Kunio Yamamoto (Univ. of Chicago). Phys. Rev., 134: B682-7(May 11, 1964).

On the basis of analyticity alone it is shown that in the high-energy limit the partial wave amplitude $a_l(s)$ for $l >$ const. $\ln^2 s$ does not contribute substantially to the scattering amplitude for finite angles. For an angle depending upon s this result can be extended to show that the contribution to the scattering amplitude $T[s, \cos\theta(s)]$ from $a_l(s)$ for $l >$ const. $\ln^2 s/\sin\theta(s)$ is smaller than any power of s. Here s and θ are the square of the energy and the scattering angle in the center-of-mass system. Classically, this means that a bombarding particle whose impact parameter is larger than the shrinking quantity const. $\ln^2 s/s^{\frac{1}{2}}\sin\theta(s)$ cannot be appreciably scattered through an angle $\theta(s)$. It is necessary to use the unitarity condition only when this result is used to put an upper bound on $T[s, \cos\theta(s)]$. Here $T(s, \cos\theta)$ is assumed to be analytic as a function of $\cos\theta$ in an s-independent complex neighborhood of the real segment (−1, 1) except for its intersection with the cuts from ∞ to x(s) and from −x(s) to $-\infty$, x(s) being an arbitrary function with $x(s) > 1$. The forward and backward peaks are discussed and it is proved that the right- (left-) hand cut contributes only to the forward (backward) peak and not to the backward (forward) peak. (auth)

21044 OVERLAPPING RESONANCES IN DISPERSION THEORY. John B. Bronzan (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 134: B687-97(May 11, 1964). (TID-19856)

The Khuri-Treiman dispersion representation is applied to the discussion of overlapping resonances among particles in production and decay final states. The kernel of the dynamical equation following from the Khuri-Treiman representation has branch points overlapping the integration contour, but recently reported work permits selection of the correct branch of the kernel. All restrictions on the masses of the final-state particles or strengths of the resonances are thus eliminated. An iteration procedure is developed for the solution of the dynamical equation when three spinless particles are present in the final state. There is no restriction on the angular momentum of the resonances, but for simplicity only s-wave resonances are considered here. Plausibility arguments are given that indicate that for narrow resonances the once-iterated approximation to the solution is a good approximation. A detailed study of all higher approximations supports this assertion. In the once-iterated approximation, one finds a branch point on the second sheet of the transition amplitude that may cause a characteristic variation of the amplitude near the low-energy boundaries of the physical region. This variation is studied quantitatively for the kinematically favorable reaction $N + N \rightarrow N + N + \pi$, and is found to be of negligible importance. The suppression of the variation is related to the threshold behavior of two-particle scattering amplitudes. (auth)

21045 UNITARY TRIPLETS AND THE EIGHTFOLD WAY. Yasuo Hara (California Inst. of Tech., Pasadena). Phys. Rev., 134: B701-4(May 11, 1964).

Four elementary baryon fields are introduced to explain the eightfold way. Three of them form a unitary triplet and the fourth is a unitary singlet. In this approach, triplets, sextets, etc., are possible multiplets, as well as singlets, octets, decuplets, etc. This model has a new quantum number, "hypercharge center." Assuming that the symmetry-breaking interactions transform like components of a triplet, selection rules in the production and decay of the triplets are derived. It is proposed that the isodoublet $\kappa(725)$ along with the isosinglet $z^+(Y = 2)$ or $\eta'(Y = 0)$ forms a unitary triplet. If the symmetry-breaking interaction transforms like a component of the octet, the symmetry suggested by Gell-Mann between four leptons and four elementary baryon fields is shown to be possible. (auth)

21046 DISSIPATION IN QUANTUM MECHANICS. TWO-LEVEL SYSTEM. [PART] II. I. R. Senitzky (Army Electronics Research and Development Labs., Fort Monmouth, N. J.). Phys. Rev., 134: A816-23(May 18, 1964).

The previous theory for two-level systems coupled to a loss mechanism (LM) is extended. First, the most general type of two-level system (TLS), in which the dipole moment is expanded in terms of the three Pauli spin matrices and unit matrix, is considered. Second, a large number of systems identical to the TLS are added to the thermal-reservoir type of LM. The TLS is described in terms of the time development of the Pauli matrices, and differential equations are obtained for their expectation value in the presence of arbitrary driving fields. The Bloch equations for a magnetic dipole of spin $\frac{1}{2}$ are exhibited as a special case, corresponding to a particular combination of the dipole vectors. All other combinations describe electric dipole systems. Equations for two simple special cases of such systems are presented. The frequency of oscillation of a freely decaying TLS is derived and shown to be shifted by an amount that depends on the relationship between the dipole vectors. The commonly held belief that any TLS can be represented as a magnetic dipole of spin $\frac{1}{2}$ is only approximately correct in the presence of dissipation. The conditions under which the differential equations for the expectation values of the TLS dynamical variables can be converted into differential equations for macroscopic variables are discussed. (auth)

21047 FERMI-LIQUID EFFECTS IN CYCLOTRON RESONANCE. P. M. Platzman and K. C. Jacobs (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 134: A974-8(May 18, 1964).

The steady-state properties of transverse circularly polarized waves propagating along a static magnetic field in a uniform plasma (metal) are considered. The Landau theory of Fermi liquids is used to compute the effect of

correlations on the reflection properties of a semi-infinite metallic plasma. The expressions are numerically evaluated and discussed for a range of parameters pertinent to the alkalis. (auth)

21048 UPPER AND LOWER BOUND OF THE EIGENVALUE OF A THREE-BODY SYSTEM. Y. C. Tang (Brookhaven National Lab., Upton, N. Y.), R. C. Herndon, and E. W. Schmid. Phys. Rev., 134: B743-7(May 25, 1964). (BNL-7704)

A variational calculation is performed to determine the upper and lower bound of the eigenvalue of the ground state of a three-body system with two types of two-body, central potential without hard core. The trial wave function used is a function that is a product of the solution of the two-nucleon Schroedinger equation up to a certain internucleon separation, which goes over into a variation function for larger distances. The calculation is done by a Monte Carlo method. The results show that with this type of trial wave function, the upper and lower bound are rather close to each other, with the difference between the values of the two bounds equal to only about 3% of the magnitude of the upper bound. (auth)

21049 WEAK-COUPLING LIMIT FOR SCATTERING BY STRONGLY SINGULAR POTENTIALS. George Tiktopoulos and S. B. Treiman (Princeton Univ., N. J.). Phys. Rev., 134: B844-7(May 25, 1964).

The validity of certain cutoff procedures, which have lately been employed in the treatment of termwise divergent perturbative expansions in nonrenormalizable field theories, is investigated in the context of nonrelativistic scattering from strongly singular repulsive potentials. For the cases considered the heuristic cutoff prescription indeed yields the correct expression for the weak-coupling limit of the phase shift. (auth)

21050 IMPROVED MINIMUM PRINCIPLE FOR MULTICHANNEL SCATTERING. Yukap Hahn, Thomas F. O'Malley, and Larry Spruch (New York Univ., New York). Phys. Rev., 134: B911-19(May 25, 1964).

If the open-channel target states are known, the minimum principle formulation of scattering theory provides a systematic monotonic approach, with arbitrary precision, to the reactance matrix K. The scattering wave function and the Green's function for the open-channel approximation, in which the closed channels are not taken into account at all, must be solved numerically. An explicit method for constructing the Green's function is given. The minimum principle approach is probably limited at present, in practice though not in principle, to the three-body problem with just a few open channels. A very useful simplification is possible at the threshold for a new channel; one need not there include the new channel in the equations that must be solved exactly. (auth)

21051 MEASUREMENT OF TIME CORRELATIONS FOR QUANTUM-MECHANICAL SYSTEMS. Marvin L. Goldberger (Princeton Univ., N. J.) and Kenneth M. Watson. Phys. Rev., 134: B919-?(May 25, 1964). (UCRL-11144)

Measurements that are of limited accuracy, are incomplete, or require a finite time to make do not generally permit the construction of a wave function for describing a physical system. The use of such partial information to predict the results of subsequent measurements is studied. There are several practical applications of this problem, including the use of the autocorrelation function for a particle counter in a scattering experiment. (auth)

21052 PROBLEM OF COMBINING INTERACTION SYMMETRIES AND RELATIVISTIC INVARIANCE. W. D. McGlinn (Argonne National Lab., Ill.). Phys. Rev. Letters, 12: 467-9(Apr. 20, 1964).

It is proved that the symmetry-interaction generators do not commute with either theLorentz translation generators or the homogeneous Lorentz generators. (M.J.T.)

21053 QUANTUM CELL MODEL FOR HARD SPHERES. Lynn Oden, Douglas Henderson, and John Coleman (Arizona State Univ., Tempe). Proc. Natl. Acad. Sci. U. S., 51: 629-34(Apr. 1964).

Thermodynamic properties of a quantum system of hard spheres were calculated using the cell model. The tunnel model was applied to a system of hard-sphere molecules at absolute zero to investigate quantum corrections inherent in the models. (R.E.U.)

21054 NEGATIVE ENERGY MOMENTS AND LOW-ENERGY APPROXIMATIONS TO PHASE SHIFTS. M. J. Roberts (London Univ.). Proc. Phys. Soc. (London), 83: 503-17(Apr. 1964).

An extension of a method derived by Buslaev and Faddeev in 1960 yields negative energy moments of partial wave scattering phase shifts. Simple analytic approximations to phase shifts, which turn out to be good at lower energies, are found in terms of the coefficients of the moment relations. They are shown to be an improvement on the effective range approximation when applied to s-wave scattering by a Gaussian potential. Combining positive and negative moments, approximations that are good at all energies for this potential are obtained. (auth)

21055 SCATTERING BY POTENTIALS WITH AN INVERSE-SQUARE ATTRACTION. M. J. Englefield (University Coll. of North Wales, Bangor, Wales). Proc. Phys. Soc. (London), 83: 519-24(Apr. 1964).

A solution is proposed for the scattering problem with an attractive inverse-square potential function. As this solution involves absorption, potentials including an inverse-square attraction may have physical applications in the description of particle absorption. The cross sections for a square well plus inverse-square attraction are calculated. Such potentials giving S and P wave resonances near zero energy, or giving minimum cross sections at zero energy, are shown by a graph specifying the potential parameters. These results show that the optical model potential is not of this form. (auth)

21056 AXIOMS FOR MULTI-LOCAL FIELDS. R. F. Streater (Imperial Coll. of Science and Tech., London). Proc. Phys. Soc. (London), 83: 549-52(Apr. 1964).

A multilocal field $\phi(x_1, \ldots, x_n)$ is defined by a set of axioms, which is a simple mathematical generalization of the Garding-Wightman axioms for a local field. The axioms are arranged so that a product of local fields $\phi(x_1)\,\phi(x_2)\ldots\phi(x_n)$ is multilocal. The role of multilocal fields in a local field theory is discussed, especially in connection with the possible existence of von Neumann algebras of local observables. (auth)

21057 OBSERVATIONAL BASIS OF MACH'S PRINCIPLE. L. I. Schiff (Stanford Univ., Calif.). Rev. Mod. Phys., 36: 510-11(Apr. 1964).

It is concluded that the observational basis of Mach's principle rests on a comparison between rotation rates of the inner-planet internal system and the fixed-stars coordinate system. The systems appear to agree within an uncertainty of about 0.4 sec/century. (M.J.T.)

21058 POISSON BRACKETS (AN UNPEDAGOGICAL LECTURE). Res Jost (Eidgenössische Technische Hochschule, Zurich). Rev. Mod. Phys., 36: 572-9(Apr. 1964).

The principal results of general analytic dynamics– in particular, properties of canonical manifolds and Liouville's theorem– are derived using only Poisson brackets. (M.J.T.)

21059 CLUSTER PROPERTY OF THE CORRELATION FUNCTIONS OF CLASSICAL GASES. David Ruelle (Institute for Advanced Study, Princeton, N. J.). Rev. Mod. Phys., 36: 580-4(Apr. 1964).

A property of absolute integrability, the cluster decomposition property of the correlation functions, is proved. Analyticity properties of the functions are discussed. (M.J.T.)

21060 NON-ABELIAN VECTOR GAUGE FIELDS AND THE ELECTROMAGNETIC FIELD. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Rev. Mod. Phys., 36: 609-13(Apr. 1964).

A theory unifying all vector gage fields partaking in both strong and electromagnetic interactions is proposed. To solve the problem of non-destruction of isotopic spin conservation by the electromagnetic field in this theory, charged leptonic fields are postulated. These leptonic fields deny higher symmetry transformations, relating the electromagnetic and non-Abelian fields, and thus give the electromagnetic field its usual physical influence. A second term violating gage invariance is hypothesized to maintain the principle of stationary action, violated by the inclusion of electromagnetic lepton interactions. The physical mass problem is considered. (M.J.T.)

21061 GENERALIZED RADIAL INTEGRALS WITH HYDROGENIC FUNCTIONS. Donald H. Menzel (Harvard Univ., Cambridge, Mass.). Rev. Mod. Phys., 36: 613-17 (Apr. 1964).

A simple method for summing long series in the calculation of radial quantum hydrogenic integrals is explained. The procedure leads to the reduction of generalized radial quantum integrals. (M.J.T.)

21062 ELECTROMAGNETIC INTERACTIONS OF A YANG— MILLS FIELD. R. J. Finkelstein (Univ. of California, Los Angeles). Rev. Mod. Phys., 36: 632-40(Apr. 1964).

The existence at parity-violating magnetic poles is investigated in relation to the vector boson (Yang-Mills) field and its hypothetical particle, the W-meson, which are used to explain weak interactions. Three solutions are possible. (1) If the photon— mediating the electromagnetic field— is the neutral member of the W-meson, spin-1 multiplet, thus violating parity, magnetic poles are not allowed and the charged bosons carry electric charge, magnetic moment, and no magnetic charge. (2) If the neutral W-boson is dual to the ordinary photon, magnetic poles are allowed and the charged bosons carry magnetic charge, electric moment, and no electric charge. (3) Both electric and magnetic monopoles exist; observed electric (magnetic) fields are due to electric (magnetic) monopoles at rest and magnetic (electric) monopoles in motion. (M.J.T.)

21063 THE VACUUM TRAJECTORY IN CONVENTIONAL FIELD THEORY. M. Gell-Mann (California Inst. of Tech., Pasadena), M. L. Goldberger, and F. E. Low. Rev. Mod. Phys., 36: 640-9(Apr. 1964).

The generation of a Pomeranchuk-like (or $\underline{P}$) trajectory in the conventional field theory of vector bosons interacting through a conserved current with spin $\frac{1}{2}$ fermions is discussed. Amplitudes of the processes $\gamma + \gamma \rightarrow \gamma + \gamma$, $N + \overline{N} \rightarrow N + \overline{N}$, and $\gamma + \gamma \rightarrow N + \overline{N}$ are investigated. It is shown that the existence of a perturbation theory vacuum trajectory is consistent with unitarity and analyticity. (M.J.T.)

21064 MINIMAL INTERACTIONS BETWEEN SPIN 0, $\frac{1}{2}$, AND 1 FIELDS. V. I. Ogievetskii and I. V. Polubarinov (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1048-55(Mar. 1964). (In Russian)

The most general lagrangian describing class A interactions for an arbitrary system of fields of spin 0, $\frac{1}{2}$, and 1 is derived under the only restriction that the coupling constants are dimensionless (minimal interactions). Some new general groups of phase transformations are indicated under which all the theories are invariant as a result of their belonging to class A. With a suitable choice of masses, the free field lagrangians are also invariant under these transformations. (auth)

21065 FUNCTIONAL INTEGRATION TECHNIQUES IN QUANTUM FIELD THEORY. John Robert Ehrman. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 69p.

The definition of an infinite-dimensional, or functional, integral is discussed, and methods are given for the evaluation of certain types of functional integrals. A technique is described for the derivation of a partial differential equation satisfied by the distribution of values of the functions in the space to be integrated over, and the relation of this distribution to certain forms of functional integrals is discussed. A generalization of a theorem of Cameron and Martin is given, and possible numerical techniques for the evaluation of functional integrals are discussed. A specific representation for the ground state functional of a non-linear model of a quantum field theory is given. A Gaussian approximation for the ground state functional is computed by the Ritz variational method, using a lattice of cells in ordinary space. The relation between the physical mass of the particles described, the cell size, and the unrenormalized mass and coupling constant is discussed. The ground state functional is also expanded in a perturbation series, and various divergent terms that appear are compared with terms in the standard Feynman-Dyson perturbation scheme. (Dissertation Abstr., 24: No. 9, March 1964)

21066 FIELD THEORY OF ELECTRONS AND PHONONS. David Alan Simkin. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 128p.

Electrons in an alkali metal were allowed to interact by multiple processes, including direct coulomb interactions and retarded phonon exchanges, by including in the Hamiltonian both coulomb interaction and electron-phonon interaction terms. Corrections to low temperature one-electron properties are discussed for actual metallic densities by obtaining expressions for the electron self-energy, $\Sigma(p)$, in terms of single-particle Green's functions. The phonon terms, including Umklapp processes, are handled by means of Bardeen's matrix elements for the electron-phonon interaction, using longitudinal coupling and subjecting all directionally dependent quantities to a spherical averaging procedure. A criterion was developed to determine when phonon terms are comparable in magnitude to coulomb terms, and when they are negligible. Migdal has shown that phonon processes often contribute small terms proportional to factors of $\sqrt{m}/M$ (where m is electron mass

and M is ion mass). In fact, phonon terms are of the same size as coulomb terms only for transitions lying within a narrow band of energies about the Fermi surface, whose width is of the order of the longitudinal phonon frequency, ω_q. This leads to the general result that physical quantities depending upon $\Sigma(p)$, such as correlation energy or paramagnetic susceptibility, should show no phonon contribution to order $\sqrt{m}/M$, while quantities such as specific heat, which depend on $(\partial\Sigma/\partial p)_p = p_F$ (density of states at the Fermi surface), show phonon contributions comparable to the coulomb contributions. A calculation of the phonon contribution to the linear electronic specific heat for sodium was made using the Noziéres-Pines interpolation scheme. Adding this to Silverstein's calculation of the coulomb terms yields a net enhancement over the free-electron value of 21 per cent. Actually, for small wave-number vectors q, $q \leq \sqrt{m}/M\ p_F$, it is shown that the electron-phonon interaction becomes just large enough to exactly cancel the divergences in the coulomb interaction perturbation series. This result depends upon the use of bare, or unrenormalized, quantities, and makes strong use of the longitudinal sum rule for phonon frequencies. A new combined form of perturbation series is proposed that consists of keeping coulomb and phonon terms together in any integration process, and which depends, for consistency, on a certain contour in the complex energy-transfer plane, chosen to avoid phonon poles. The series does not use any infinite sums (screening) and has the advantage of being consistently defined for all q (no interpolation) in the region of actual metallic densities. A first order specific heat calculation predicts an enhancement of 32% over the free-electron value for sodium. (Dissertation Abstr., 24: No. 9, March 1964)

21067 QUANTUM FIELD THEORY AND THE MANY-BODY PROBLEM. T. D. Schultz. The Many-Body Problem. Current Research and Reviews. Volume I. New York, Gordon and Breach Science Publishers, 1964. 156p. Paper $3.95, Cloth $6.95.

Recent developments in the theory of the many-body problem that depend on the formalism of quantum field theory are discussed. The presentation is limited to the perturbation theory approach using diagrams. Second quantization and the Heisenberg and Schroedinger quantum mechanical time development of a system are discussed. Many-fermion systems at absolute zero, the electron-phonon system at absolute zero, and many-fermion systems at finite systems are considered. 50 references. (R.E.U.)

21068 AN ANALYTIC REPRESENTATION OF THE INVARIANT DISTRIBUTIONS OF QUANTUM FIELD THEORY. Frank Bartlett Thiess. Thesis, Stanford, Calif., Stanford Univ., 1963. 182p.

"Invariant distribution" means any of the commutators and propagators associated with a quantized particle field. It is shown that all the invariant distributions of a given noninteracting field are boundary values of one and the same matrix of analytic functions, called the "particle kernel" of the field. The invariant distributions are represented as integral operators on a space of analytic test functions, where the defining integrations are over 4-dimensional hypersurfaces in the 8-dimensional space of 4 complex variables and employ the "particle kernels" as integration kernels. The theory of free particles is examined in the light of these "analytic representations" for the invariant distributions and is shown to possess a structural simplicity and some interesting symmetry properties. The analytic theory developed for free fields is used to investigate the perturbation treatment of particle interactions. A formalism is given for expressing scattering matrix elements in terms of the analytic representations mentioned above. A study is made of scattering processes, which shows that the analytic formalism developed in this paper is equivalent to the standard formalism of field theory whenever operations within the standard formalism are well defined. When the operations in the standard formalism are not well defined because formal products of invariant distributions occur, these invariant distributions may be multiplied in a very natural way within the analytic formalism. Using an "analytically" defined multiplication for invariant distributions, the singularities that cause the ultraviolet divergences of field theory can be isolated and examined. In the analytic formalism, no δ-functions appear, and consequently the matrix elements of field theory may be evaluated using only operators that are defined within the context of complex analysis. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21069 ON THE QUANTUM YANG-MILLS FIELD. Edward Antoine Remler. Thesis, Chapel Hill, N. C., Univ. of North Carolina, 1963. 70p.

The quantum theory of a generalized Y-M field coupled to a Dirac-spinor field is considered. The cross sections for all of the lowest order processes are derived. Lowest order radiative corrections to the classical field equations are evaluated in a gauge invariant fashion. Certain aspects of the formalism, such as gauge invariance and factor ordering, are discussed. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21070 THE CALCULATION OF TRANSPORT PROPERTIES OF A QUANTUM SYSTEM. William Warren Longley, Jr. (Martin Co., Denver). 122p. (CONF-479-1)

From American Physical Society, Division of Plasma Physics, Colorado Springs, Colo., Nov. 1961.

The problem of developing transport coefficients of a quantum system from the basic equations of motion is investigated. The basic Kubo formalism for developing linear transport coefficients is extended to include bulk viscosity and thermal conductivity. Derivations of these two coefficients are new. However, the results are known from other work. The bulk viscosity derivation depends on a transformation of position and momentum operators that is identified with a change of system volume. Thermal conductivity derivation depends on a position dependent transformation of single-particle energies that is identified with a temperature gradient. Thermal conductivity of a simple model is evaluated by perturbation-expansion techniques. The four lowest orders in the perturbation series are calculated under the assumption that the autocorrelation expression vanishes after a sufficient period of time. A relaxation time that may be written as a power series starting with the inverse second power of the coupling constant is found. Additional terms that indicate a memory effect are also present, starting with the zero order term. The possibility of using resolvent formalism for calculation of transport coefficients from Kubo-type expressions is also investigated. The transport coefficients can be expressed easily in terms of the density matrix, the formal solutions of the generalized master equations, and the operators for the dynamic fluxes. (auth)

Geophysics

Refer also to abstracts 20288 and 20707.

21071 HIGH-LATITUDE BOUNDARY OF THE OUTER RADIATION ZONE AT 1000 KM. I. B. McDiarmid and

J. R. Burrows (National Research Council, Ottawa). Can. J. Phys., 42: 616-26(Apr. 1964). (NRC-7798)

Particle detectors on the Alouette satellite were used to determine the average high-latitude boundary of the outer radiation zone at 1000 km as a function of local time. The boundary for electrons with energies greater than 40 kev is approximately symmetrical with respect to the noon-midnight meridian and occurs at the highest latitude near local noon, shifting between 4 and 5° to its lowest value near local midnight. There is very little difference in the average boundaries of so-called trapped and precipitated electrons. The results are discussed in terms of measurements of electrons with similar energies in the equatorial plane and models of the earth's magnetic field. (auth)

21072 ATMOSPHERIC WAVES FROM U.S.S.R. NUCLEAR TEST EXPLOSIONS IN 1962. Bhartendu and B. W. Currie (Univ. of Saskatchewan, Saskatoon). Can. J. Phys., 42: 632-7(Apr. 1964).

Photographic reproductions of the records of the A_1 wave systems at Saskatoon (52.1°N., 106.6°W.) from five nuclear test explosions in Novaya Zemlya during the summer of 1962 are given. Notable differences exist between some of the records. These may be due to differences in the heights of the explosions. Dispersion curves of group velocity against period are shown. Waves ranged in period from 6.0 to 0.8 minutes; group velocities from 275 to 313 m/sec. (auth)

21073 SPECTROGRAM OF ARTIFICIAL AURORA NEAR SAMOA OF JULY 9, 1962, AND ASSOCIATED LITHIUM EMISSION IN TWILIGHT. B. A. Tinsley (Univ. of Canterbury, Christchurch, N. Z.). Can. J. Phys., 42: 779-93(Apr. 1964).

Observations made from Western Samoa of the artificial auroral display in the region magnetically conjugate to the nuclear explosion of July 9, 1962, are described. Notable features of the display were its great intensity (6.5×10^6 Rayleighs for [OI] 5577 Å), the presence of helium emissions, and characteristics of helium or heavier particle excitation. Lithium emission was found to be present in twilight for observations made up to six days after the explosion. (auth)

21074 A NOTE ON THE THERMAL HISTORY OF THE EARTH AND THE POSSIBLE ORIGIN OF A SOLID INNER CORE. A. E. Beck (Univ. of Western Ontario, London). Can. J. Phys., 42: 825-9(Apr. 1964).

The theory of the earth's thermal history is investigated, taking account of the nonuniform energy density distribution from both the initial energy of accretion and the subsequent energy released in gravitational reorganization. The origin of a solid inner core is discussed. (M.J.T.)

21075 ION KINETICS IN THE LOWER IONOSPHERE. R. C. Whitten and I. G. Poppoff (Stanford Research Inst., Menlo Park, Calif.). J. Atmospheric Sci., 21: 117-33(Mar. 1964).

Various positive and negative ionic processes of importance in controlling the electron density in the lower ionosphere are discussed. In particular, models of the effective dissociative recombination coefficient based on laboratory and ionospheric experiments are constructed. Rate constants for charge transfer and ion-atom interchange in this region are determined from various in situ measurements, and the results are compared with the corresponding laboratory data. Processes involving negative ions are treated next, and suggestions that O_2^- is not the dominant negative ion are shown to be entirely reasonable. Finally the diffusion of electrons to dust is discussed, and it is shown that this diffusion can not constitute an important mode of electron removal. (auth)

21076 PROPAGATION OF HYDROMAGNETIC WAVES IN THE LOWER EXOSPHERE AND THE ORIGIN OF SHORT PERIOD GEOMAGNETIC PULSATIONS. J. A. Jacobs and T. Watanabe (Univ. of British Columbia, Vancouver, Can.). J. Atmospheric Terrest. Phys., 24: 413-34(1962).

The exospheric region below an altitude of about 2000 km, where the Alfvén velocity has a very steep upward gradient, amplifies hydromagnetic waves coming from outer space with certain special periods. The longest characteristic period, corresponding to the fundamental mode, is of the order of from 1 to several seconds, which is comparable to the period of that particular group of geomagnetic micropulsations called pearls. The fundamental period has a frequency-width of the order of 0.02 to 0.08 sec^{-1}, which is of the right order of the time-scale of fluctuations of the envelope of the pearls. The amplifying ratio also gives the correct order of magnitude of the intensity of pearls as observed at the earth's surface. (auth)

21077 PROPAGATION OF WEAK HYDROMAGNETIC SHOCK WAVES IN THE EXOSPHERE AND GEOMAGNETIC VARIATIONS DUE TO HIGH ALTITUDE NUCLEAR EXPLOSION. Tohru Araki (Kyoto Univ.). J. Geomagnet. Geoelec., 15: 126-32(1964).

Propagation paths are calculated for weak hydromagnetic shock waves (fast mode) from a point source lower than 3000 km above sea level. It is shown that the shock waves of this type have a tendency to propagate easily in the direction of the geomagnetic meridian. The results are compared with the observed geomagnetic disturbances due to the small scale high-altitude nuclear explosion (Argus III). A qualitative agreement is obtained between the theoretical and the observational results. (auth)

21078 THE ELECTRICAL STATE OF THE UPPER ATMOSPHERE. Tatsuzo Obayashi (Kyoto Univ.). J. Geomagnet. Geoelec., 15: 133-47(1964).

The electrical nature of the upper atmosphere is reviewed with an emphasis on those problems that might be considered as belonging to the regime of space electricity. The physical structure and electrodynamic behavior of the ionosphere are explained in terms of an interacting ternary gas of electrons, ions, and neutral particles under the influence of the geomagnetic field. The concept of an atmospheric dynamo is important, producing strong currents and electric polarization fields in the lower ionosphere. In the exosphere, the behavior of gas is essentially hydromagnetic. Possible mechanisms for generating electric fields by magnetospheric convective motions are discussed. (auth)

21079 FREQUENT OCCURRENCE OF LOCAL GEOMAGNETIC DISTURBANCE IN HIGH LATITUDES. Naoshi Fukushima and Takeo Hirasawa (Tokyo Univ.). J. Geomagnet. Geoelec., 15: 161-71(1964).

Occurrence of local geomagnetic disturbance in high latitudes is studied through a simple analysis of the sudden increases in the quarter-hourly geomagnetic Q-indices (by 3 in successive 15-minute intervals or by 4 within an hour) reported from 17 stations for the one-year period from July 1957 through June 1958. About 80% of the sudden increases of Q-index are recorded only at a single station, and this indicates a very frequent occurrence of local magnetic agitation, such as bay-like disturbances or pulsations of large amplitude. The region of local disturbance is in most cases in a quadrant of the polar map with only several

degrees of latitudinal range. The local disturbances occur more frequently in winter than in summer. In winter the appearance of local geomagnetic disturbance is concentrated around midnight, while in summer it appears rather uniformly at all times of day. The winter predominance of the sudden increase of Q-indices may come mainly from the fact that the noise level of magnetic disturbance in summer is remarkably higher than that in winter. (auth)

21080 Be^{7}, P^{32}, P^{33}, AND S^{35}: STRATOSPHERIC CONCENTRATIONS AND ARTIFICIAL PRODUCTION. P. J. Drevinsky, J. T. Wasson, E. C. Couble, and N. A. Dimond (Air Force Cambridge Research Labs., Bedford, Mass.). J. Geophys. Res., 69: 1457-67(Apr. 15, 1964).

Cosmic-ray-produced ^{7}Be, ^{32}P, ^{33}P, and ^{35}S radioactivities were measured in aircraft filter collections made at 20 km over the central United States during 1961 and 1962. Fission products ^{140}Ba and ^{90}Sr were measured in the same samples. Observed concentrations of the natural radionuclides were close to the predicted equilibrium levels before the resumption of nuclear weapons tests by the Soviet Union in 1961. Strong evidence of artificial production of ^{32}P and ^{35}S during the 1961 Soviet tests was found. These nuclides were also produced during the 1962 United States tests, and there is also evidence for the production of ^{7}Be and ^{33}P during the latter test series. The artificial production can be satisfactorily explained by a consideration of possible target materials in the weapons and of the radiations present in nuclear explosions. (auth)

21081 EXCITATION OF SEISMIC SURFACE WAVES BY ATMOSPHERIC NUCLEAR EXPLOSIONS. M. Nafi Toksoez and Ari Ben-Menahem (California Inst. of Tech., Pasadena). J. Geophys. Res., 69: 1639-48(Apr. 15, 1964).

The Rayleigh waves generated by nuclear explosions in the atmosphere and by earthquakes are investigated to determine the relative effects of the source and the propagation medium on the observed amplitude spectrums. It is found that when the waves from a given source propagate along different paths the shapes of the spectrums change markedly. Comparison of earthquake- and explosion-generated waves leads to the conclusion that the source characteristics are obscured by the propagation effects. The theoretical expression for the spectrum of the Rayleigh wave displacement is derived for an explosion in a homogeneous atmosphere. The yield of the explosion introduces a frequency-dependent factor into the equations. Using this frequency dependence, the relative yields of explosions are computed from the amplitude-spectrum ratios of Rayleigh waves recorded at a distant station. (auth)

21082 BALLOON OBSERVATIONS OF VERY INTENSE ARTIFICIAL RADIOACTIVITY IN AUTUMN 1962. A. M. Conforto (Universita, Rome), F. Mariani, S. Cantarano, A. Egidi, and M. Terenzi. J. Geophys. Res., 69: 1658-62 (Apr. 15, 1964).

Observations of exceptionally high counting rates above the cosmic-ray background detected on three occasions for several hours at atmospheric pressures between 90 and 10 mb are reported. No explanation for the exceptional increases can be found in terms of cosmic-ray phenomena. It is proposed that these increases are likely due to radioactive debris connected with U. S. and Soviet nuclear testing. (C.E.S.)

21083 MEASUREMENTS OF PLANETARY ELECTRIC CURRENTS. S. K. Runcorn (Univ. of Newcastle-upon-Tyne, Eng. and California Inst. of Tech., Pasadena). Nature, 201: 10-13(Apr. 4, 1964).

Theories of an electric current generated by the earth's magnetic field are presented. Preliminary measurements of the current were undertaken, using telephone cables in the Pacific Ocean near Australia. Voltage at the ends of the cables, one end being "earthed" under the ocean, was measured. The voltage differences were taken to eliminate the dominant tidal currents. An approximately sinusoidal earth current with a period of 12 hours and a potential gradient of less than 0.1 mv/km was obtained. (M.J.T.)

21084 ENERGY SOURCES FOR THE IONOSPHERIC ELECTRONS. A. P. Willmore (University Coll., London). Nature, 201: 41-2(Apr. 4, 1964).

From an examination of experimental data, it is concluded that the observed electron temperature distribution can be explained by heating from trapped electrons (2 to 3 kev and about 8×10^{9} cm^{-2} sec^{-1}) and from photoelectrons produced by sunlight. (M.J.T.)

21085 GEOPHYSICAL EFFECTS OF 1962 U. S. HIGH ALTITUDE NUCLEAR TESTS (OBSERVED IN ROCHESTER, NEW YORK). R. A. Santirocco and D. G. Parker (General Dynamics/Electronics, Rochester, N. Y.). Proc. Indian Acad. Sci., Sect. A, 59: 77-92(Feb. 1964).

Simple geomagnetic observations made of the large high altitude nuclear test of 9 July 1962 are described. Coordinated geophysical measurements of the electromagnetic effects from the four tests which took place in October and November 1962 are discussed. The measurements included (a) the three spatial components of the geomagnetic noise field, (b) the N-S earth current field, (c) broadband VLF noise, and (d) phase fluctuations in the VLF signal from NPG in Jim Creek, Washington. The observations of the 9 July test were elementary in nature and did not yield much quantitative information. The results of the much weaker, lower altitude tests in October and November showed evidence of a prompt, zero-delay signature followed by a delayed pulse some 4-7 sec later. An apparent transient phase shift effect was seen about 12 sec after the instant of detonation. A phase shift of the neutron-decay type was seen only on 1 November. The observations show agreement with geomagnetic measurements made during the Argus tests of 1958. (auth)

21086 SYNCHROTRON EMISSION FROM ELECTRONS IN THE EARTH'S MAGNETIC FIELD. Glen Lamar Hower. Thesis, Stanford, Calif., Stanford Univ., 1963. 88p.

The general characteristics of synchrotron emission are reviewed, and previous theoretical work is summarized. The effects of various parameters on the intensity, spectrum, and beamwidth of the emission are discussed. Results are presented graphically. General techniques are given for computing the emission per electron and the total emission from a group of electrons. The particular case of emission from electrons trapped in the earth's magnetic field over the geomagnetic equator is discussed. The computational techniques are applied to the case of noise generated following the 9 July, 1962 high-altitude nuclear explosion. The computed results are found to be in excellent agreement with experimental observations. The techniques are also applied to the case of emission from high-energy electrons spiraling about the magnetic field over the auroral zone. These results indicate that the synchrotron mechanism offers a probable explanation for some previous observations of vhf auroral noise during severe disturbances. An experimental program for studying the auroral noise phenomena is outlined. (Dissertation Abstr., 24: No. 8, Feb. (1964))

21087 THE EARTH'S RADIATION BELTS AND THE AURORA. E.-Å. Brunberg (Royal Inst. of Tech., Stockholm). p.113-24 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The shape and composition of the earth's radiation belts are described. Conditions for particles to be trapped in a magnetic field are given. Possible origins of the belt radiation are suggested. The Argus experiment is briefly related. Some auroral properties are listed, and theories (Stormer, Chapman-Ferraro, Alfvén) to explain the aurora and geomagnetic storms are described. (M.J.T.)

21088 MECHANISM OF V.L.F. EMISSION. R. E. Gendrin (Service d'Aeronomie de l'Observatoire, Meudon, France). p.125-34 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The spectrum at very-low-frequency electromagnetic noise (0.5 to 20 kc) is described. Previous theories for v-l-f production through cyclotron radiation or traveling wave amplification mechanisms are discussed. The possibility of v-l-f emission by Cherenkov effect is investigated. (M.J.T.)

21089 OPTICAL ASTRONOMY ABOVE THE EARTH'S ATMOSPHERE. J. M. Greenberg (Rensselaer Polytechnic Inst., Troy, N. Y.). p.235-46 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Limits on spectrum observations caused by the earth's atmosphere are discussed. Data of solar extreme ultraviolet fluxes in the upper atmosphere are presented. Facts and models of stellar and interstellar-medium spectra are summarized. (M.J.T.)

21090 THE U. S. PROGRAM FOR PARTICLES AND FIELDS MEASUREMENTS IN SPACE. G. H. Ludwig (National Aeronautics and Space Administration, Washington, D. C.). p.320-47 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

The objectives of NASA are outlined. Satellite investigations of energetic particles and magnetic fields—experiments completed through May 1961 and those proposed for the future—are discussed. NASA's launching vehicles and spacecraft are described. (M.J.T.)

21091 THE BRITISH SPACE RESEARCH PROGRAMME. E. B. Dorling (University Coll., London). p.386-91 of "Cosmic Rays, Solar Particles and Space Research." New York, Academic Press, 1963.

Skylark-rocket atmosphere studies and the satellite tracking program are described. Plans for experiments to be carried in U. S. Scout satellites and eventually in joint-European satellites are mentioned. (M.J.T.)

21092 THERMAL REACTIONS INVOLVING CHARGED PARTICLES. A. Dalgarno (Queen's Univ., Belfast). 7p. (CONF-462-2)

From the Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

The mechanisms of the production and loss of charged particles in the upper atmosphere are described and attention is drawn to the processes that require further experimental study. (auth)

21093 NEGATIVE IONS IN AFTERGLOWS IN ATMOSPHERIC GASES. Wade L. Fite and J. A. Rutherford (General Dyanmics Corp., General Atomic Div., San Diego, Calif.). 13p. (CONF-462-4)

From The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

Mass spectrometric monitoring of ions in afterglows in atmospheric gases was applied to the study of negative ions. Nitrogen + oxygen + hydrogen mixtures as well as the pure gases and ordinary air were examined in a bakeable afterglow mass spectrometer. For pressures of the order of 1 torr and after times of the order of milliseconds, minute impurities produce negative ion spectra, which bear little resemblance to those that could be expected. Especially significant are the ions CO_3^- (mass 60) and $NO_3H_2^-$ (mass 64). It seems likely that many of the atmospheric phenomena usually attributed to O_2^- and NO_2^- involve these and other heavier ions. (auth)

21094 REACTION RATES DETERMINED FROM IONOSPHERIC OBSERVATIONS. R. C. Whitten and I. G. Popoff (Stanford Research Inst., Menlo Park, Calif.). 8p. (CONF-462-6)

From The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Apr. 1964.

Some recent D- and E-region measurements were used to compute relaxation parameters. Solar flare x-ray data obtained during the Sun Flare II program, together with an 18-Mc sudden cosmic noise absorption record, were used to compute an effective dissociative recombination coefficient corresponding to ~80 km altitude. It was found to be about 5×10^{-7} cm^3 sec^{-1} to within a factor of about 2. Relative ion concentration data obtained in the altitude region 110 to 200 km are used to compute rate constants for several charge rearrangement processes, which are believed to be the dominant ones in the E-region. Several of them agree quite well with laboratory measurements, but one does not. Possible reasons for the disagreement are discussed. (auth)

Low Temperature Physics

Refer also to abstract 20789.

21095 (NBS-8239) CRYOGENIC MAGNET REFRIGERATION. Interim Report. D. B. Mann, M. T. Norton, and T. R. Strobridge (National Bureau of Standards. Boulder Labs., Boulder, Colo.). Feb. 1, 1964. 129p.

Refrigeration processes (Joule-Thomson expansion, Brayton cycle, Stirling cycle, and Claude cycle) were investigated, together with the reheat concept. The applicability of conventional turbine design methods to refrigeration systems was demonstrated. Efficiencies of 80% in a turbine supported by gas-lubricated bearings were achieved. A pulsed refrigeration system for cooling a magnet with pressurized helium gas was studied extensively. A proposed steady-state refrigeration system to remove heat from the circulating system is discussed. Refrigerant properties were also put into readily usable, up-to-date form. (D.C.W.)

21096 (NP-13809) SUPERCONDUCTIVITY. Report R-181. C. B. Satterthwaite (Illinois. Univ., Urbana. Coordinated Science Lab.). Sept. 1963. Contract DA-36-039-AMC 02208(E). 24p.

Some of the more important experimental and theoretical developments in superconductivity are reviewed, and some associated technological developments (cryotron circuits and superconducting magnets) are discussed. (D.C.W.)

21097 (UCRL-7308-T) CONCERNING THE QUANTIZATION OF FLUX. J. W. Zink (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 1963. Contract W-7405-eng-48. 5p.

The deviation of the flux trapped within a ring of super-

conducting material from an integral multiple of $\hbar c/2e$ is explained, and increasing the deviation to permit its detection is discussed. Extension of the concepts involved to an orbiting electron in an atom is also considered. (D.C.W.)

21098 METALLURGICAL ASPECTS AND SUPERCONDUCTING CURRENT CAPACITIES OF Nb–Zr ALLOYS. Kyôji Tachikawa and Bin Okai (National Research Inst. of Metals, Tokyo). Nippon Kinzoku Gakkaishi, 28: 16-21 (Jan. 1964). (In Japanese)

Nb–Zr alloys containing 28 to 57% Zr were fabricated into strips 5/100 mm in thickness and also into wires 0.25 mm in diameter. The cold workability of the alloys was improved by high vacuum electron beam melting and by forging at high temperatures. Phase transformation during various heat treatments was studied by x-ray diffraction. Specimens were found to have fine lamellar structures after the eutectoid reaction at 560°C or after decomposition into two bcc phases at 785°C. The latter heat treatment at 785°C decreases the hardness and facilitates subsequent cold working at room temperature. The heat treatment at 560°C deteriorates the cold workability. The superconducting critical current I_c is increased considerably by cold working and is also sensitive to heat treatments. The decomposition reaction at 785°C and the eutectoid reaction at 560°C are both effective in increasing I_c, whether the specimen is cold worked or not. The intermediate heat treatment at 785°C for about 10 hr between successive cold working is quite profitable because of the improvement of both cold workability and superconducting current capacity. (auth)

21099 THERMOELECTRICITY IN THE INTERMEDIATE STATE. A. M. Guénault (National Research Council, Ottawa). Phil. Mag. (8), 9: 331-3(Feb. 1964).

Comments on the note by Ohta (1963) on a thermal resistivity maximum in the intermediate state of a superconductor are made and modifications are proposed. (L.B.S.)

21100 THEORY OF THE ELECTRONIC THERMAL CONDUCTIVITY OF SUPERCONDUCTORS WITH STRONG ELECTRON-PHONON COUPLING. Vinay Ambegaokar (Cornell Univ., Ithaca, N. Y.) and Ludwig Tewordt. Phys. Rev., 134: A805-15(May 18, 1964).

The electronic thermal conductivity of superconductors is discussed without recourse to the quasi-particle approximation. The Kubo formula for the thermal conductivity is used as the starting point. This is first examined in the Hartree-Fock approximation in the Nambu space. It is shown that, in the Eliashberg approximation of neglecting the momentum dependence of the electronic self-energy, the calculation of the thermal conductivity is reduced to a quadrature, involving however the complex energy gap and renormalization functions which are solutions of the Eliashberg gap equations at finite temperatures. These equations are given in an Appendix. The problem is also considered in the ladder approximation in the Nambu space, and a generalized Boltzmann equation, which includes corrections to the Hartree-Fock approximation corresponding to the replacement of the scattering by the transport cross section, is derived. It is shown that the standard Boltzmann equation for superconducting quasiparticles is obtained in the weak-coupling limit. A clear scheme for numerical calculations is outlined. Reasons for believing that such calculations will explain the anomalous drop in the electronic thermal conductivity of superconducting lead are given. (auth)

21101 SURFACE SUPERCONDUCTIVITY IN TYPE I AND TYPE II SUPERCONDUCTORS. Myron Strongin, Arthur Paskin, Donald G. Schweitzer, O. F. Kammerer, and P. P. Craig (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. Letters, 12: 442-4(Apr. 20, 1964).

The real and imaginary parts of types I- and II-superconductor a-c susceptibility were measured in both parallel and perpendicular d-c magnetic fields. A surface superconducting layer with critical field H_{c3} was found to exist for parallel external field if H_{c3} was only barely above the bulk critical field. Preliminary measurements demonstrating that H_{c3} can exist in a pure material as well as an alloy were made. (M.J.T.)

21102 SUPERCONDUCTIVITY IN SEMICONDUCTING $SrTiO_3$. J. F. Schooley (National Bureau of Standards, Washington, D. C.), W. R. Hosler, and Marvin L. Cohen. Phys. Rev. Letters, 12: 474-5(Apr. 27, 1964).

The finding of superconducting transitions in samples of reduced strontium titanate is reported. The transitions occurred at ~0.25 and 0.28°K. It was ascertained that the superconductivity was a bulk effect. (C.E.S.)

21103 SUPERCONDUCTIVITY IN ANTIFERROMAGNETS. W. Baltensperger and S. Straessler (Technische Hochschule, Zurich). Physik Kondensierten Materie, 1: 20-6(1963).

In a perfect spin up spin down antiferromagnet B.C.S. electron pairs are described, which are coupled by only a slightly decreased effective interaction. A repulsive interaction is added by virtual spin wave excitation. Depending on the relative strength, superconductivity may exist in such an antiferromagnet. (auth)

21104 INVESTIGATION OF THE SUPERCONDUCTIVITY OF THE Zr–Rh ALLOY. Werner Buckel, Gerald Dummer, and Wolfgang Gey (Technische Hochschule, Karlsruhe, Ger.). Physik Kondensierten Materie, 1: 67-77(1963). (In German)

The transition temperatures of Zr–Rh alloys with small amounts of Rh are essentially higher than the transition temperature of pure Zr. Rhodium is not dissolved in the Zr lattice. In the unannealed specimens Rh stabilizes the body-centered-cubic phase, which has a T_c of 6.4°K. After annealing an intermetallic compound is formed with a T_c of about 12°K. This compound is also formed in the unannealed specimens at higher Rh content. (auth)

21105 COHERENCE LENGTH AND PENETRATION DEPTH OF DIRTY SUPERCONDUCTORS. C. Caroli, P. G. de Gennes and J. Matricon (Service de Physique des Solides, Orsay, France). Physik Kondensierten Materie, 1: 176-90(1963).

The properties of non-magnetic superconducting alloys, in the vicinity of the transition point are considered. It is shown that to a good approximation the coefficients of the appropriate Landau-Ginsburg equation can be computed at all concentrations, by making use of simple sum rules. The final results depend only on the residual resistivity of the alloy in the normal state. (auth)

21106 SUPERCONDUCTIVITY. P. W. Anderson (Bell Telephone Labs., Inc., Murray Hill, N. J.) and B. T. Matthias. Science, 144: 373-81(Apr. 24, 1964).

Superconductivity is discussed first theoretically by Anderson and then experimentally by Matthias. The nature and development of a scientific theory is described. The band theory of semiconductivity is given as an example. The BCS theory of superconductivity is explained, and is compared with the Schafroth, Blatt, Butler theory. The predictions of the BCS theory and their confirmation or clarification by experiment are discussed for transition temperature, energy-gap function, and isotope effect. From

the experimental point of view, all theories of superconductivity are merely working models. Several examples of theories both confirmed and contradicted in various respects by experiment are cited. The occurrence of superconductivity is described for nontransition and transition metals. The relation of ferromagnetism and superconductivity is discussed. (M.J.T.)

21107 SOME PROBLEMS IN THE THEORY OF SUPER-CONDUCTIVITY. Chun-hsien Chen, Shih-kan Chen, and Yu-ping Huai. Wu Li Hsueh Pao, 17: 31-40 (Jan. 1961). (In Chinese)

Several problems in the contemporary theory of superconductivity are considered on the basis of the Green's function method. The physical pattern of superconductivity is discussed, and the possibility of the existence of elementary excitations of the type q^2/m associated with the pair migration of Cooper and its physical consequences are investigated. (tr-auth)

21108 SUPERCONDUCTION OF GALLIUM AT HIGH PRESSURES. Werner Buckel and Wolfgang Gey (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 176: 336-50(1963). (In German)

A high-pressure modification of gallium was formed at liquid helium temperature by the application of a pressure in excess of 35,000 atm. It was superconducting with a transition temperature of 6.38°K. The high-pressure form remained after the pressure was removed at helium temperature. This resulted, however in a shift in transition temperature to 7.5°K. The average derivative dT_c/dp was -3.10^{-5}°K/atm. (auth)

21109 EFFECT OF ELECTRON MEAN FREE PATH ON THE UPPER CRITICAL MAGNETIC FIELD OF HARD SUPERCONDUCTING TIN. Rolfe E. Glover (Univ. of Maryland, College Park). Z. Physik, 176: 455-63(1963).

The upper critical field H_n of tin was studied as a function of temperature and of the normal-state residual resistivity. Material was prepared by condensation on a cold substrate and the resistivity changed in steps by suitable annealing. A linear relation between the resistivity (proportional to the reciprocal of the electron mean free path) and the upper critical field H_n was observed. This was in agreement with predictions of Gor'kov based on the Ginzburg-Landau-Abrikosov theory of hard superconductors. (M.C.G.)

21110 ON THE SUPERCONDUCTION IN MIXED SYSTEMS WITH Nb_3Sn. R. Hagner (Universität, Giessen, Ger.). Z. Physik, 177: 10-27(1964). (In German)

By replacement of part of the tin in Nb_3Sn by its neighboring elements in the periodic system, the mean valence electron number per atom in the mixed systems obtained was varied. Their influence on the transition temperature to superconduction was investigated by resistance and induction measurements. The samples were prepared by sintering techniques, in which a uniform sintering temperature serviceable for all systems was used. A separation of the influences of valence electron number and mass was attempted by substitution for tin by binary element combinations with the same average valence electron number. The influences of elements substituted for tin and of tin deficiency alone on the transition temperature were checked and compared. On the basis of the Debye-Scherrer theory the incorporation of substitution elements to obtain evidence was attempted. The influence of the different substitution elements stood in part in opposition to the Matthias rule, however, by a slight modification of the rule (according to DeSorbo) it could be understood. (tr-auth)

21111 THE TUNNELING CURRENT BETWEEN TWO SUPERCONDUCTORS. Albert Schmid (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 178: 26-38(1964).

The tunneling current was calculated for a model in which the insulating layer is represented by a potential barrier of infinite height and vanishing width. The calculation method used avoided the usual description of the tunneling process by means of an effective perturbation energy; the results however, which contained expressions for the tunneling of quasiparticles as well as for Cooper pairs, agreed within the exactness sought with the results that were obtained with the help of the effective perturbation energy. (M.C.G.)

21112 ON THE SUPERCONDUCTIVITY OF TERNARY β-TITANIUM ALLOYS. Ch. J. Raub (Univ. of California, San Diego, La Jolla). Z. Physik, 178: 216-20(1964). (In German)

The elements Sc to Cu, Y to Ag, and La to Au were dissolved in β-Ti-Rh alloys and the superconducting behavior of these ternary mixed crystals was investigated. The pattern of the transition temperature-concentration curve was largely the same of elements with 3d, 4d, and 5d electrons and could be explained on the basis of the Matthias rule from the change of the valence electron concentration, N. With increasing valence electron concentration the transition temperature of the alloy increased, passed through a maximum of about 4°K between N = 4.4 and 4.6, and again decreased. Only Mn and Re, as well as in certain senses the Ru and Os alloys deviated from the increasing trend of the T_c-N curve, which could be explained on the basis of the magnetic properties of the elements concerned. (tr-auth)

21113 EFFECT OF IMPURITIES ON THE SUPERCONDUCTING TRANSITION TEMPERATURE IN THALLIUM. B. G. Lazarev, L. S. Lazareva, V. I. Makarov, and T. A. Ignateva (Inst. of Physics and Tech., Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 829-30(Mar. 1964). (In Russian)

The effect of impurities of elements with various valency and atomic radii on the superconducting transition temperature (T_c) of thallium is investigated. Impurities with a valency below that of thallium (Hg,Cd) lower T_c; impurities with valencies exceeding that of thallium (Bi,Sb) increase T_c. Impurity elements with different atomic radii also affect T_c differently. It thus seems that in thallium as in other superconductors the effect of impurities on T_c is due to changes in the electron free path and to differences in valency and radii of the atoms of the metal and impurities. (auth)

21114 ON THE CRITICAL MAGNETIC FIELDS OF SUPERCONDUCTING NIOBIUM FILMS. I. G. Dyakov, B. G. Lazarev, A. A. Matsakova, and O. N. Ovcharenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Eksperim. i Teor. Fiz., 46: 831-2(Mar. 1964). (In Russian)

Thin superconducting niobium films are obtained. It is shown that the critical fields of the films are much higher than in the massive metal and depend on the film thickness. The critical fields of films of two different thicknesses and the critical temperatures are estimated. A possible relation between the high critical parameters of solid superconducting alloys and the superconducting properties of films is indicated. (auth)

21115 ON FOURTH SOUND IN A He^3-He^4 SOLUTION. D. G. Sanikidze and D. M. Chernikova (Inst. of Cybernetics, Academy of Sciences, Georgian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1123-5(Mar. 1964). (In Russian)

The velocity of fourth sound (waves in which only the superfluid part of the liquid oscillates) in a $^3He-^4He$ solution is calculated. (auth)

21116 THEORY OF IMPURITY EFFECTS UPON THE CRITICAL TEMPERATURE OF ANISOTROPIC SUPERCONDUCTORS. David Markowitz. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 93p.

The changes in critical temperature upon doping a superconductor are accounted for theoretically by solving a BCS-like model that includes anisotropy. This anisotropy is introduced via a factorable pairing potential $V_{pp'} = [1 + a(\hat{\Omega})]V[1 + a(\hat{\Omega}')]$, which depends on the momenta of the paired particles relative to the crystal axes. The computational scheme used is that of thermal matrix Green's functions. An expansion for the self-energy in terms of the interacting potentials and the full Green's functions converges exceedingly rapidly. The solution obtained is in the form of an integral equation for the gap function, which depends on temperature, angle, and energy. This equation manifestly obeys Anderson's theorem, which states that T_c is unaffected by the addition of impurities whenever the electron-electron interaction is assumed independent of particle momenta within a range about the Fermi surface. The equation is specialized to $T = T_c$ and numerically solved for the physically interesting case when the squared relative anisotropy averaged around the Fermi surface is small compared to unity, i.e., $\langle a^2 \rangle \ll 1$. The impurities have two effects upon T_c: they gradually change the gross properties of the system and hence produce a linear change in T_c, and in addition, they abruptly reduce T_c by reducing the anisotropy of the energy gap. By adjusting parameters representing the strengths of these effects, theory was fit to experiments on Sn, In, and Al alloy systems. It was found that $\langle a^2 \rangle \approx 0.02$ for Sn and In, and $\langle a^2 \rangle \approx 0.01$ for Al. The number $\langle a^2 \rangle$ is the anisotropy parameter characteristic of the host. The coefficient of δT_c^0, the linear portion of δT_c, is a number characteristic of the alloy system of host and impurity. It is empirically decomposed into two main parts and the mechanisms originating each part are traced. The first part is a true valence effect, while the second is a mean free path effect. Part of the valence effect is attributed to the alteration in the density of states at the Fermi surface, N(0). By second quantizing an interaction Hamiltonian describing the coupling of electrons to a doped lattice, it was found that the average pairing potential V contributes significantly to both the valence and mean free path parts. A Pines-like model for estimating the former is discussed. Very satisfactory agreement was found between the theory and a variety of experimental data. (Dissertation Abstr., 24: No. 9, March 1964)

21117 NUCLEAR MAGNETIC RESONANCE IN SUPERCONDUCTING VANADIUM FILMS. Richard Juul Noer. Thesis, Berkeley, Calif., Univ. of California, 1963. 81p.

Thin film NMR samples were made of superconducting vanadium in pressures of less than 10^{-6} mm Hg, with thicknesses of 500, 200, and 100 Å. After marked aging effects, these had normal state NMR linewidths typical of bulk V and superconducting linewidths consistent with calculated superconducting field exclusion. The transition temperatures were, respectively, 4.5, 3.6, and 2.8°K; a large fraction of the films in the 100 A sample did not superconduct. The spin-lattice relaxation rate $1/T_1$ in the fully superconducting 200 Å sample was proportional to the temperature to within 20% in both normal and superconducting states, and less than 4% change was seen in the metal NMR shift from normal to superconducting state at 0.4 T_c. Results on the 100 Å sample were consistent with these. A discussion of susceptibility and nuclear shielding in metals shows that the formerly neglected orbital contribution is important in vanadium; it is estimated that the lack of any change in superconducting metal shift implies less than 9% change in that part of the total susceptibility due to the ordinary Pauli spin susceptibility. The behavior of T_1 is attributed to the lack of an energy gap in these samples. (Dissertation Abstr., 24: No. 9, March 1964)

21118 SUPERCONDUCTING MAGNET DESIGN. D. Bruce Montgomery (Massachusetts Inst. of Tech., Cambridge). 47p. (CONF-307-3)

From Canadian Electronics Conference, Toronto, Sept.-Oct. 1963.

The advent of the high field superconducting materials has prompted the exploration of a number of potential uses: d-c magnets of high field and/or superstability are most attractive and have received wide spread attention. Design considerations for superconducting magnets are presented, and include a discussion of wire characteristics, design formulas, economic factors, coil protection, mechanical stresses, dewars, and power supplies. Some brief considerations for energy storage, a-c devices, power transmission, and flux conservation are also presented. (auth)

21119 STABILITY OF FILM BOILING TWO-PHASE FLOW IN CRYOGENIC SYSTEMS. T. H. K. Frederking (Univ. of California, Los Angeles). New York, American Institute of Chemical Engineers, 1964, Preprint 21b, 35p, $0.50. (CONF-393-4)

From American Institute of Chemical Engineers Symposium on Techniques at High Pressures, Memphis, Feb. 1964.

Various aspects related to disturbances and stability of film boiling in cryogenic systems are discussed. Three different types of unstable modes are referred to by considering simple examples: the operation of the whole system including supply elements; oscillations of the vapor-liquid interface; and the transition from stable (laminar) to unstable (turbulent) vapor film motion. In the first case the heat flux has a component in the direction of the gravity or governing field force such that a hydrostatically stable density distribution (vapor above liquid) results. For this flow pattern the unstable modes start to have a measurable effect on the quasi-laminar heat transfer at film Reynolds numbers not higher than 400. The second case with a heat flux component opposite to the field force implies very strong instabilities and very short distances of stable (quasi-laminar) flow. In numerous cases (simply connected bodies with lower and upper stagnation point, inclined tubes) the angle between field force and flux changes locally, and the critical film Reynolds number can be lowered to the order 10. The results suggest that the vapor motion in saturated film boiling is quasi-laminar only over that part of heat emitting surface that produces a vapor volume of order B^3 contained within a departing bubble. (P.C.H.)

Neutron Physics

21120 (AMRA-TR-63-25) A SUBTHERMAL NEUTRON BEAM COLLIMATED BY TOTAL REFLECTION. Charles R. Porter (Army Materials Research Agency,

Watertown Arsenal, Mass.). Dec. 1963. 49p. (AD-433615)

A method for providing an experimental beam of long wavelength neutrons was investigated. Neutrons travel from the vicinity of a reactor core to the experimental area by means of a curved hollow tube. The phenomenon of total internal reflection of long wavelength neutrons is used to selectively transport subthermal neutrons the length of the tube. The general shape and position of the spectrum of emerging neutrons was investigated as a function of the tube curvature, the internal finish of the tube, and the reflective material inside the tube. Gammas and fast neutrons were not able to negotiate the curvature of the tube; and, as a result, the beam obtained was virtually free from contamination. (auth)

21121 (BNL-7958) USE OF COLD NEUTRONS IN SOLID STATE RESEARCH. Harry Palevsky (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 32p. (CONF-475-1)

From the Conference on Nuclear Spectroscopy and Solid State Physics, Lima, Feb. 1964.

The interactions of neutrons and x rays with atoms are compared and contrasted, and the inelastic scattering of cold neutrons is discussed. The apparatus used in the cold neutron experiments is then described, and some results obtained by this technique are reviewed. (D.C.W.)

21122 (EUR-1605.e) A COMPARISON BETWEEN THE CODES FOR THE CALCULATION OF THERMAL SPECTRA IN HOMOGENEOUS MEDIA. M. G. Tamagnini and C. Ponti (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy). 1964. 27p. (CONF-469-1)

From the Conference on Physics of Reactors, Milan, Nov.-Dec. 1963.

The differences in the spectra obtained by using with the same scattering kernel the three codes SOFOCATE, THESIS II and THERMOS or by using different kernels in the same code were investigated. The cross sections library was the same for all the calculations. Infinite mixtures of absorbers in H_2O or D_2O moderators were considered. (auth)

21123 (GA-4972) GAPLSN—A MODIFIED DSN PROGRAM FOR THE SOLUTION OF THE ONE-DIMENSIONAL ANISOTROPIC TRANSPORT EQUATION. J. H. Alexander, G. W. Hinman, and J. R. Triplett (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Mar. 16, 1964. 57p.

GAPLSN is an extended version of DSN, a FLOCO-II program for one-dimensional neutron and photon transport problems. GAPLSN features anisotropic representation of the scattering cross section and also the external source by an arbitrary number of angular moments. GAPLSN may be used with any version of the FLOCO-II system for the IBM 7090. (R.E.U.)

21124 (IA-800) ABSOLUTE CALIBRATION OF NEUTRON SOURCES BY THE MANGANESE SULPHATE BATH METHOD. Y. Gurfinkel and S. Amiel (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Sept. 1963. 26p.

The method of absolute calibration of neutron sources by means of the manganese sulphate bath was studied systematically with the aim of improving its sensitivity and extending its applicability to neutron sources of different spectra. The sensitivity and precision of the method were increased by using a single dipping scintillation spectrometer to count the ^{56}Mn produced in the bath and by optimizing counting duration. A suggestion is made for improving the sensitivity further by inserting an array of detectors to count the total radioactivity present in the bath, since the effective detection range of a single detector was found to be limited to a radius of about 25 cm. The experimental procedure was modified to make it simpler and faster. Overall errors of 1.7% for sources of 10^6 n/sec, and 2.0% for sources of 10^4 n/sec for a single dipping scintillation spectrometer are reported. Using an array of eight dipping counters, low intensity sources in the 10^3 n/sec range may be calibrated with an overall error of 2.2% as compared with 9% obtained with a single counter. The major component of the overall errors, is the 1.5% error introduced by the 4 $\pi\beta$ standardizations. (auth)

21125 (KR-64(Sect.XXIII)) TREATMENT OF POLARIZED THERMAL NEUTRON BEAMS. O. Steinsvoll (Norway. Institutt for Atomenergi, Kjeller).

Various aspects of the interactions of polarized neutron beams with magnetic fields are reviewed, with particular attention to spin-flip mechanisms. (T.F.H.)

21126 (KR-64(Sect.XXIV)) MULTIPLE MIRROR REFLECTION OF THERMAL NEUTRONS. F. Stecher-Rasmussen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). 17p.

Experimental studies are reported on the multiple reflection of thermal neutrons in multichannel collimators. (T.F.H.)

21127 (KR-64(Sect.XXV)) EXPERIMENTS WITH POLARIZED NUCLEI AND POLARIZED NEUTRONS. H. Postma (Leiden. Universiteit). 17p.

The transmission of polarized neutrons through targets containing polarized nuclei is discussed. Measurements of this type are used to determine spins of low-energy neutron resonances. Depolarization and energy spread of the beam are taken into account. The measurements may be used to obtain information on the internal magnetic fields acting on the target nuclei. (T.F.H.)

21128 (KR-64(Sect.XXVI)) STUDIES OF THE β DECAY OF THE NEUTRON. C. J. Christensen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). 19p.

Measurements of parameters and matrix elements for neutron beta decay are reviewed. (T.F.H.)

21129 (KR-64(Sect.XXVII)) NEUTRON HALF-LIFE EXPERIMENTS. C. J. Christensen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). 15p.

A review is presented of measurements of the neutron half life for beta decay. Various experimental methods are taken into account. (T.F.H.)

21130 (KR-64(Sect.XXX)) FILTERS, SHIELDING AND TARGETS. H. Postma (Leiden. Universiteit). 10p.

An outline is given of means for filtering and shielding neutron beams, and of target requirements for these beams. (T.F.H.)

21131 (PAN-279) MAGNON SCATTERING OF SLOW NEUTRONS ON A PYRRHOTITE SINGLE CRYSTAL. Adam Wanic (Institut za Nuklearne Nauke "Boris Kidric," Belgrade). Sept. 1963. 32p.

The magnetic inelastic scattering of the monoenergetic beam of neutrons, $\lambda_0 = 1.376$ Å, on a natural single crystal of pyrrhotite $Fe_{1-\delta}S$ was investigated. The scattering surface connected with $\tau = (00.1)$ was examined by means of the Cracow Neutron Spectrometer installed by the TVRS reactor in Vinca. The energy analysis together with the diffraction method were applied and are described. The

results are interpreted in the range of spin wave theory. Spin wave (magnon) dispersion relation for the acoustical branch was obtained and its anisotropy discovered. Evidence for the optical branch was also found. A model is proposed which gives account of the observed phenomena when relevant calculations are performed. (auth)

21132 (RPI-328-4) ENERGY-DEPENDENT EXTRAPOLATION LENGTH MEASUREMENTS IN POLYETHYLENE. R. Fullwood, R. Slovacek, R. Cerbone, and E. Gaerttner (Rensselaer Polytechnic Inst., Troy, N. Y.). [1963]. Contract AT(30-3)-328. 6p. (CONF-446-2)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The extrapolation length in the diffusion approximation for polyethylene was determined from asymptotic neutron spectrum measurements using the pulsed electron linac-phased neutron chopper technique. The spectrum was found to be remarkably stable against reentrant hole size. Extrapolation lengths are plotted versus energy for neutron energies up to 0.2 ev. Transport mean-free-paths are also shown. Integration of the paths gives a diffusion constant of $D_0 = 24800 \pm 3600$ cm/sec. (D.L.C.)

21133 (TID-20503) ONE-SPEED NEUTRON TRANSPORT IN TWO ADJACENT HALF-SPACES. M. R. Mendelson and G. C. Summerfield (Michigan. Univ., Ann Arbor). [1962]. Contract [AT(11-1)-917]. 29p.

Using Case's method for solving the one-speed transport equation with isotropic scattering, the Milne problem solution, the solution for a constant source in one half-space, and the Green's function solution are obtained for two adjacent half-spaces. (auth)

21134 (TID-20540) TRANSPORT SOLUTION OF THE ONE-SPEED SLAB ALBEDO PROBLEM. Norman J. McCormick and M. R. Mendelson (Michigan. Univ., Ann Arbor). [1963]. Contract [AT(11-1)-917]. 18p.

Case's method of normal mode expansion is applied to the slab albedo problem (the problem of finding the angular density in a bare slab with monodirectional neutrons incident upon one face). The problem is reduced to determining expansion coefficients which are shown to depend upon the solution of two nonhomogeneous Fredholm integral equations. Using Neumann iteration to solve for the coefficients, explicit solutions are obtained for the angular density, scalar density, and net current in zero and first order approximations. (auth)

21135 (UCRL-7006-T) A SIMPLE PROCEDURE FOR PROPERLY INCLUDING ANISOTROPIC SCATTERING IN NEUTRON SLOWING-DOWN CALCULATIONS. John R. Terrall (California. Univ., Livermore. Lawrence Radiation Lab.). July 1962. Contract W-7405-eng-48. 22p.

A more general theory for neutron slowing down due to multiple scattering is presented that takes into account anisotropic scattering while retaining reasonable simplicity. The relation developed between the slowing down density and the flux spectrum at a given energy is exact for moderation by hydrogen, even with arbitrary energy variations of the flux, and for an E^{-1} flux-in energy, regardless of the scatterers or scattering laws involved. With arbitrary flux variations, even when hydrogen is not involved, it accounts for the first derivative of the flux-in-lnE exactly. (D.C.W.)

21136 SPECTRA OF THE FAST NEUTRONS OF A POLONIUM–BERYLLIUM SOURCE PASSING THROUGH A WATER SHIELD. G. G. Doroshenko and I. V. Filyushkin. At. Energ. (USSR), 16: 152-3(Feb. 1964). (In Russian)

In view of the absence of literature data on the spectra of neutrons emitted by sources based on the (α,n) reaction after their passage through shielding materials, the effect of passing through water on the fast neutron spectrum of a Po–Be source was experimentally and theoretically investigated. A stilbene fast-neutron spectrometer was used for determining the spectra, measured in a semi-infinite and in barrier-type geometry, using 10, 20, 30, and 40-cm thick water layers. In the latter case, the total neutron flux rate on the detector was 7.7 n/cm^2 sec for a period of 3 hours. By increasing the thickness of the water layer, the shape of the spectrum was primarily affected by the energy dependence of the total interaction cross section of the neutrons with 0 nuclei. In the case of a semi-infinite medium, the theoretical and experimental values agreed well with each other. The attenuation curve of the source at thicknesses from 0 to 20 cm appeared to be strongly influenced by changes in the nature of the spectrum. (TTT)

21137 FLUXES OF FAST- AND MODERATED NEUTRONS IN LOCALITIES. P. S. Otstavnov. At. Energ. (USSR), 16: 154-5(Feb. 1964). (In Russian)

Fast neutron fluxes with energies $E_n > 1.4$ Mev and resonance and thermal neutron fluxes, emitted by neutron sources based on the D(d,n)^{3}He, Be(d,n)^{10}B, and T(d,n)^{4}He reactions with neutron energies of 600 kev, were measured, using a spiral fission chamber with natural U layer or filled with BF_3 as detector. The flux measurements showed that in a cube-shaped room, containing the source in the center, the resonance neutron flux remains constant within 30% and the thermal flux within 20% throughout the room while the fast neutron flux decreases, according to the $1/R^2$ law, with the distance. If the wall contains heavy materials, such as Fe, reflected neutrons disturb this law. Measurements in rooms with a volume of 4.7, 27, 139, and 4900 m^3 and in open space revealed that the fast neutron flux in various points of the space remained constant within 10% and the flux ratio changed only if amounts of resonance and thermal neutrons changed. The moderated neutron background was lowest in the center and it depended on the volume approximately in proportion with $V^{-\frac{1}{3}}$. Formulas were derived for calculating the moderated neutron flux on the basis of the differential equation of Fermi. (TTT)

21138 THE AGE OF Po–Be NEUTRONS IN DOWTHERM-A. M. A. J. Rathur (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 437-9(Apr. 1964).

The spatial distribution of indium resonance neutrons was determined from the change in counting rate when a cadmium-covered neutron sensitive scintillation counter was covered by an indium absorber. The method was used to determine the age of Po–Be neutrons in Dowtherm-A. (auth)

21139 NEUTRONS FOR SMALL LABORATORIES. H. W. Nass (Union Carbide Nuclear, Tuxedo, N. Y.), R. S. Maddock, and W. W. Meinke. J. Chem. Educ., 41: 156-8 (Mar. 1964). (TID-19148)

The use of two small commercially available neutron sources for teaching and research was explored, and their operation is discussed with respect to shielding, safety, output, useful life, cost, and experimental applicability. The Kaman Model NT 60-8 pulsed neutron generator and the Nuclear-Chicago Neutron Howitzer were evaluated. Comparison of the results of these irradiations with those made with the Kaman accelerator previously discussed shows the Howitzer to compare favorably with the generator. The small neutron generator with its replaceable generator tube is primarily suited for short (20-sec to 15-min) irradiations with either fast or slow neutrons.

The Howitzer can be used for many types of nuclear investigations requiring irradiations of a wide time range. (BBB)

21140 ONE-SPEED NEUTRON TRANSPORT IN TWO ADJACENT HALF-SPACES. M. R. Mendelson and G. C. Summerfield (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.), 5: 668-74(May 1964).

The Milne problem solution, the solution for a constant source in one half-space, and the Green's function solution are obtained for two adjacent half-spaces, using Case's method for solving the one-speed transport equation with isotropic scattering. These problems have been solved previously by other methods. (auth)

21141 ANISOTROPY OF DIFFUSION CONSTANT IN MEDIA WITH EMPTY CHANNELS. M. Copic, T. Kalin, G. Pregl, and F. Zerdin (Nuclear Inst. "Jozef Stefan", Ljubljana, Yugoslavia). Nucl. Sci. Eng., 19: 74-9(May 1964).

The thermal-neutron diffusion constant was measured in a plexiglas system with empty channels, using the pulsed-neutron-source technique. From separate sets of measurements on rectangular blocks, the diffusion constants parallel and perpendicular to channels were determined, whereas the measurements on cubes give the average diffusion constant. The results are compared with existing theoretical estimations. It is found that the average diffusion constant is well below the theoretical predictions of Behrens. On the other hand, the difference between the parallel and the perpendicular diffusion constant is almost as large as predicted theoretically. (auth)

21142 SOME TRANSIENT PHENOMENA IN THERMALIZATION. 1. THEORY. Noel Corngold (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 19: 80-90 (May 1964). (BNL-7461)

The behavior of the asymptotic thermal flux in "pulsed" and "exponential" experiments is discussed. A pair of theorems is given that bear upon the possibility of measuring λ_0 and L in certain cases. One shows that all $\lambda_i(B^2)$ disappear at sufficiently large B^2, the other that all space decay constants disappear at sufficiently large concentration of absorber. (auth)

21143 SOME TRANSIENT PHENOMENA IN THERMALIZATION. II. IMPLICATIONS FOR EXPERIMENT. Noel Corngold and Paul Michael (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 19: 91-4(May 1964). (BNL-7462)

In a previous paper some general properties of the Boltzmann equation governing the transient behavior of neutron distributions were developed. The experimental consequences of these considerations are examined and some reported experimental results are discussed. It is found that in some cases theoretical restrictions on time-decay constants and diffusion lengths are apparently violated. (auth)

21144 SOME RESULTS ON THE ENERGY-DEPENDENT MILNE PROBLEM FOR THERMAL NEUTRONS AND LIGHT GASES. C. Eisenhauer (National Bureau of Standards, Washington, D. C.). Nucl. Sci. Eng., 19: 95-101(May 1964).

The thermal-neutron flux near the boundary of a semi-infinite nonabsorbing gas, which scatters neutrons isotropically, was studied. The THERMOS code was used to obtain numerical solutions to the integral transport equation. The properties of the flux, integrated over all energies, at the surface of the semi-infinite medium were found to be very insensitive to variations in the scattering properties of the medium. (auth)

21145 THERMAL NEUTRON SPECTRUM IN A MODERATOR WITH A TEMPERATURE DISCONTINUITY. R. M. Pearce and J. M. Kennedy (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nucl. Sci. Eng., 19: 102-7(May 1964).

The variation in space of the thermal-neutron spectrum close to a temperature discontinuity in a nonabsorbing free gas was calculated in the diffusion approximation on a G-20 computer. This spectrum forms a basis for testing two simple rethermalization models. The two-overlapping-group model due to Selengut gives very good agreement with the computer calculations when used with an improved transfer cross section. The single-Maxwellian model in which the neutron temperature varies exponentially with distance from the discontinuity does not give as good agreement. (auth)

21146 NEUTRON THERMALIZATION IN GRAPHITE. N. F. Wikner, G. D. Joanou, and D. E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 19: 108-29(May 1964). (GA-4169)

The ability to understand thermal-neutron spectra in graphite-moderated reactor systems is examined on the basis of a theoretical description of neutron scattering that begins at the microscopic level. The first step in this examination consists in determining the extent to which current ideas of lattice vibrations in graphite are consistent with measurements of the scattering law and of specific heats. Theoretical scattering laws and specific heats based on a few different models for lattice vibrations are compared with experimental results. The theoretical scattering law is calculated within the framework of the incoherent and Gaussian approximations. The question of the accuracy of the latter approximation is discussed in detail. No estimates are made of the magnitude of the uncertainty introduced by the use of the incoherent approximation. Following the discussion of neutron scattering at the microscopic level, (1) the sensitivity of various integral properties of the scattering kernel and of thermal-neutron spectra in a homogeneous medium to the frequency distribution of lattice vibrations, and (2) the accuracy of the Gaussian approximation for use in computing thermal-neutron spectra in graphite are shown. A detailed theoretical model for the scattering of neutrons by graphite is applied to the problem of comparing calculated neutron spectra with the measured spectra in two strongly heterogeneous, graphite-moderated assemblies. These considerations show that current theoretical ideas concerning the frequency distribution of lattice vibrations in graphite are consistent with the results of the measurement of the scattering law, with the specific heat, and with most of the available results of the measurements of thermal-neutron spectra in reactor-like configurations. 23 references. (auth)

21147 THE EFFECT OF CHEMICAL BINDING ON THE MILNE-PROBLEM EXTRAPOLATION DISTANCE. M. M. R. Williams (Univ. of Birmingham, Eng.). Nucl. Sci. Eng., 19: 132-3(May 1964).

The effects of chemical binding and thermal motion on the extrapolation distance in the thermal-neutron Milne problem with isotropic scattering from a nonabsorbing medium are discussed. (R.E.U.)

21148 MEASUREMENT OF NEUTRON SLOWING-DOWN TIME IN WATER. Agam Prakash Shukla and Arthur Waltner (North Carolina State Coll., Raleigh). Nukleonik, 6: 1-3(Feb. 1964).

The slowing-down time of Am–Be source neutrons to the cadmium edge was measured by the double-pulse technique. A liquid scintillator was used for the generation of both

pulses. The first pulse was produced by the ^{12}C de-excitation gamma ray of 4.43 Mev indicating the birth of the neutron and the second was due to gamma rays resulting from its capture in Cd. The first pulse triggered a time analyzer and the second one was sampled with reference to the first pulse. The $CdCl_2$ solution was in an annular volume surrounding the liquid scintillator. The Cd/H atomic ratio was 0.006. The time distribution of the second pulse relative to the first had a maximum of 2.2 μsec indicating the most probable time for neutron capture in this medium. (auth)

21149 ON THE THEORY OF PROMPT-DECAY CONSTANTS AND CORRELATED SPECTRA IN MULTIPLYING MEDIA. PART I. Karl-Heinz Joest (Entwicklungsabteilung der Interatom, Bensberg, Ger.). Nukleonik, 6: 3-8 (Feb. 1964). (In German)

The problem of decaying eigenstates in a multiplying slab system was investigated in the B_0-approximation. The problem of a correlation between the eigenvalue s and the static value of k_{eff} was analyzed by an s-expansion. The general analysis of the prompt decay constant was performed in the usual manner by a B^2-series expansion. The integral equations for the spectrum and the integral representations of the eigenvalue were established for the different orders of B^2. For non-multiplying and 1/v-absorbing media the formulas of M. Nelkin were arrived at. For infinite-multiplying media the prompt decay constant can be regarded as the difference between total loss probability and total prompt production probability. The second order coefficient, which is closely related to the diffusion properties in non-multiplying media, appears to be changed by the explicit dependence on fission properties. (auth)

21150 ON THE THEORY OF PROMPT-DECAY CONSTANTS AND CORRELATED SPECTRA IN MULTIPLYING MEDIA. PART II. Karl-Heinz Joest (Entwicklungsabteilung der Interatom, Bensberg, Ger.). Nukleonik, 6: 8-14(Feb. 1964).

Under the assumption of a cut-off energy for up-scattering processes a rigorous separation of the thermal and the slowing-down range was performed. A good approximation of the eigenvalue problem restricted to the thermal region could be formulated with a feedback function including an integral representation of the reactions involved in the slowing-down process. This form was especially useful for the discussion of the decay constant as well as for the derivation of approximate formulas for the eignevalue and the effective absorption in the spectrum in a prompt decaying eigenstate. Performing a B^2 series expansion resulted in a zero order decay constant equal to $(1-k_{p,0})\ 1/l_0$ with the lifetime being the sum of slowing-down time and the thermal lifetime, appropriately reduced for nonthermal neutron cycles. The main contribution of the second order approximation is the importance weighting of the sum of the mean square displacements in the fast and thermal region by the corresponding lifetimes. It appears impossible to express the decay constant as a function of k_{eff} and l only with the lifetime defined as the reciprocal loss probability per sec. The form of the decaying thermal spectrum corresponds approximately to a stationary spectrum with 1/v-absorption of the strength $p\epsilon(1-\beta)\nu\Sigma_f$. (auth)

21151 HIGHER OPTICAL DISTRIBUTION FUNCTIONS. Andrej Sauer (Allgemeine Elektricitats-Gesellschaft, Frankfurt am Main). Nukleonik, 6: 37-9(Feb. 1964). (In German)

The DIRAC optical distribution function of a body can be used in their usual form only for problems in which the distribution of incident neutrons on the surface of the body is isotropic. A generalization of this function for the case in which the incident current has an angular distribution proportional to $(n \cdot \Omega)^m$ was developed and used for approximate calculations of absorption properties of cylindrical control rods. (tr-auth)

21152 THE EFFECTS OF FLUX ANISOTROPY ON THERMAL NEUTRON FLUX PERTURBATIONS. Jack Vernon Walker. Thesis, College Station, Tex., Agricultural and Mechanical Univ., 1963. 133p.

The effects of neutron-flux anisotropy upon thermal-neutron-flux perturbations were found by experimentally determining the perturbations induced by foils placed in fluxes of known angular distributions. Anisotropies in the magnitude of the vector flux were introduced by placing a "black" Cd absorber sheet in an isotropic flux produced by a uniform slowing-down source in water. The resulting angular distribution of the thermal neutron flux was computed. Using In foils with thicknesses from 14 to 184.9 mg/cm^2, the flux perturbations were measured to within ±1% in regions varying from a highly directional flux near the cadmium surface to an essentially isotropic distribution several mean free paths from the absorber. The dependence of flux perturbation on neutron angular distribution was studied theoretically by investigating the change in the modified Skyrme theory due to the anisotropies present in the experiment. The effects of the neutron temperature change on the calculated flux perturbations were also investigated. The theoretical predictions that the flux depression would decrease in the region of a boundary were experimentally verified. The experimental data indicated that the flux perturbation remained constant at all distances greater than ~5 mean free paths from the nonreentrant boundary but decreased in the region near the boundary. It was concluded that this decrease was due to both neutron angular distribution and temperature changes. The temperature and anisotropy effects were separated, and it was observed that, with the temperature effect removed, the flux perturbation remained constant at all distances greater than ~3 mean free paths but decreased significantly near the boundary. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21153 ENERGY-DEPENDENT NEUTRON TRANSPORT THEORY. Anthony Leonard. Thesis, Stanford, Calif., Stanford Univ., 1963. 116p.

The energy-dependent Boltzmann equation for neutrons in a homogeneous medium is studied. A complete set of solutions to the source-free equation is found for the case of plane symmetry and isotropic scattering in the laboratory system. Both continuum (singular) and discrete (regular) solutions are found. The solutions are shown to have completeness properties (in neutron direction and energy), which permit a conventional normal mode expansion of the solution to most transport problems of interest (subject to the restrictions of plane symmetry and isotropic scattering). In some cases the discrete expansion coefficients may be calculated by means of an orthogonality property of the solutions. In all cases, the continuum and discrete coefficients may be calculated from the results of the completeness proofs. In the case of cross sections independent of energy, the Boltzmann equation may be reduced to a denumerable set of uncoupled "one-velocity" equations. Several of the standard neutron transport problems are solved in the general energy-dependent case, and numerical results are obtained using the heavy-gas model of the energy transfer operator. The solutions are compared with dif-

fusion theory solutions, and it is found that the diffusion theory results are correct only for small absorption and the first discrete mode. Therefore, space-dependent spectral calculations should not be done with diffusion theory in heavily absorbing media or near disturbances that may excite higher modes. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21154 AN ABSTRACT APPROACH TO A PROBLEM IN NEUTRON TRANSPORT THEORY. Kennard Wendell Reed, Jr. Thesis, New York, New York Univ., 1963. 29p.

A mixed-initial and boundary valued problem was formulated for the transport equation, in the case in which the material, D, through which the neutrons travel, varies with time. By restricting the deformation to take place along rays emanating from some fixed point, 0, of D, some of the results of Kato, in his work on the abstract evolution equation, can be applied to get the existence of a unique solution. Thus it is possible to exhibit the solution in the form of an evolution operator applied to the initial data. This would be of physical interest since, if overheating causes D to expand, then it is reasonable to assume that the expansion occurs in just this manner. Next, an energy inequality was derived for this problem, in the general case of arbitrary but smooth deformations of D. The equation is approximated by step functions in the variable, v. The integral term of the equation degenerates into a sum, and an associated mixed-problem for a symmetric hyperbolic system of equations was obtained. The components of the solution for this system are the steps of a step function that approximates the desired solution. Using the energy inequality, the limit can be passed to an appropriate norm. Thus, the sense, in which the transport equation may be regarded as a limiting case of hyperbolic equations, shows up nicely. In particular, there exists a notion of characteristics for the transport equation, being the limit of the characteristics of the approximating hyperbolic equations. Finally these results would be relevant in cases of explosions, or of extending the critical size in such a way that catastrophic results do not occur. (Dissertation Abstr., 24: No. 9, March 1964)

21155 ON THE NUMERICAL SOLUTION OF THE MULTIGROUP EQUATION. D. R. Edwards and K. F. Hansen (Massachusetts Inst. of Tech., Cambridge). 9p. (CONF-187-123)

From American Nuclear Society Meeting, New York, Nov. 1963.

A new method for numerical solution of neutron multigroup diffusion equations is discussed. The method differs from other techniques in the form of the iteration used to locate the eigenvalues and calculate the corresponding eigenfunctions. The method reduces computation time by a large factor at the expense of some loss of accuracy due to increased truncation error. (C.E.S.)

Nuclear Properties and Reactions

Refer also to abstracts 20023, 20386, 20388, 21471, and 21593.

21156 (AEEW-R-351) THE DATA IN THE WINFRITH NUCLEAR DATA LIBRARY, JULY 1963. E. P. Barrington, A. L. Pope, and J. S. Story (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Feb. 1964. 49p.

The data in the Winfrith Library on H, H_2O, D, D_2O, ^3He, ^4He, Be, BeO, B, ^{10}B, C, N, O, F, Na, Al, Si, Cr, Fe, Ni, Cd, ^{133}Xe, Pb, ^{232}Th, ^{235}U, ^{238}U, ^{239}Pu, and ^{240}Pu are discussed. Isotopic abundances, atomic and molecular weights, reaction Q values, and resonance parameters are covered in addition to the cross sections when appropriate. The data sources are indicated, together with other recent compilations. Revisions to the data files are suggested. 59 references. (D.C.W.)

21157 (AFOSR-5284) EXPERIMENTAL STUDIES IN NUCLEAR PHYSICS. Final Report, August 1, 1962–June 30, 1963. Franklin B. Shull (Washington Univ., [St. Louis]). Contract AF49(638)-843. 26p. (AD-417349)

The Mössbauer effect in β-tin for 1.3 to 370°K is reported. The differential cross sections for alpha production by deuteron bombardment of ^9Be, ^{14}N, ^{19}F, ^{27}Al, ^{31}P, and ^{51}V, which were reported previously, are compared with predictions of theoretical models. Progress in the redevelopment program for the Washington University cyclotron is discussed. (R.E.U.)

21158 (BNL-7836) DATA SIMULATION WITH AN ON-LINE COMPUTER AS A DIAGNOSTIC AND ANALYTICAL TOOL. James F. Mollenauer (Brookhaven National Lab., Upton, N. Y.). Feb. 19, 1964. Contract AT-30-2-GEN-16. 10p. (CONF-182-7)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963.

A hybrid approach was adopted in the use of an on-line computer in setting up and analyzing nuclear physics experiments. In addition to the usually cited advantage of on-line flexibility and the ability to do off-line calculations, the general purpose computer can simulate data by presenting the results of off-line calculations to the experimenter in a format identical to that used for data display. As compared with off-line calculations at a computer center with subsequent hand or machine plotting, the use of the build-in display hardware provides a more convenient comparison of theory with experiment, as well as greater ease and speed. The advantages of on-line data transformation are preserved without accompanying limitations on the rate of data taking. The data from the experiment consisted of energy correlations in two-particle coincidence experiments. The loci of points in energy-energy space fulfilling energy and momentum conservation were calculated, displayed, and photographed before each experimental run. Interpretation of the experimental data was assisted by modulation of the loci (of the number of counts per channel) according to the predictions of various models. (auth)

21159 (CEA-2399) MESURE DE LA SECTION EFFICACE TOTALE DE L'ALUMINIUM, DU CARBONE, DU FLUOR ET DE L'HYDROGENE POUR DES NEUTRONS DE LA REACTION d,d PAR LA METHODE DES COINCIDENCES. (Total Cross-Section Measurements of Aluminium, Carbon, Fluorine and Hydrogen for Neutrons From the d,d Reaction Using the Coincidence Method). G. Ambrosino and A. Sorriaux (France. Institut National des Sciences et Techniques Nucleaires, Paris). 1963. 21p.

The experiment described consists in the measurement of the total cross section of various materials: aluminum, carbon, fluorine and hydrogen, for monoenergetic 2.77 Mev neutrons obtained from the d,d reaction. The measurement is carried out by transmission. The neutrons are detected by means of a plastic scintillator mounted on a 56 AVP photomultiplier, and are isolated from all secondary phenomena (background noise, scattered neutrons) by coincidence with helium-3, which particles are associated to the neutrons from the reaction $d(d,n)He^3$. The helium-3 particles are detected by a PN junction diode used with inverted

polarization. An absorption exponential has been traced out using measurements made on seven aluminum bars. The accuracy of the total cross section measurements is about 10^{-2}. (auth)

21160 (CONF-231-5) MEASUREMENT OF THE RATE FOR $\mu^- + He^3 \rightarrow H^3 + \nu$. R. M. Edelstein (Carnegie Inst. of Tech., Pittsburgh); D. Clay, J. W. Keuffel, and R. L. Wagner, Jr. (Utah. Univ., Salt Lake City). [1963]. Contracts AT(30-1)-1825 and AT(11-1)-82. 9p.

From the International Conference on Fundamental Aspects of Weak Interactions, Upton, N. Y., Sept. 1963.

The reaction rate for $\mu^- - {}^3He \rightarrow {}^3H - \nu$ was measured using a high-pressure, ^3He, gas scintillation counter as the target for stopping muons. A value of 1450 ± 75 sec^{-1} was obtained, in agreement with other experiments and with the prediction based on the universal Fermi interaction with conserved vector current. (D.C.W.)

21161 (CONF-417-26) ELASTIC SCATTERING OF DEUTERONS FROM Ni^{60} AND Cd^{114}. J. K. Dickens and F. G. Perey (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 8p.

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

A previous study of deuteron elastic scattering by medium- and heavy-weight nuclei within the framework of an optical model showed that the surface imaginary potential (W_d) decreased sharply between $E_d \sim 11$ and 15 Mev and increased slowly above 15 Mev. To investigate this energy dependence, angular distributions for deuterons elastically scattered from ^{60}Ni between 5 and 13.5 Mev were measured. The subsequent analysis indicated that the behavior of W_d may be due to absolute normalization of the cross sections and, more importantly, indicated a new variation in optical-model parameter space. Angular distributions for scattering by ^{114}Cd at 7 to 15 Mev were obtained and analyzed to test a proposal for the observed increase in the real well depth with decreasing deuteron energy. (D.C.W.)

21162 (CONF-481-3) OBSERVATION OF THE $\frac{1}{2}$+ (411) ORBITAL IN Ho^{165}. M. E. Bunker, J. W. Starner, and F. P. Cranston, Jr. (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 10p.

From American Physical Society Annual Meeting, New York, Jan. 1964.

Gamma-gamma coincidence measurements were made in the decay of isomeric ^{165}Dy. Energy shifts and expected state mixing between the $\frac{1}{2}$+ and $\frac{3}{2}$+ rotational bands in ^{165}Ho were calculated. Observations of the unusual $\frac{1}{2}$+ (429.4 kev) level in ^{165}Ho are discussed. (R.E.U.)

21163 (CONF-481-4) PHOTOPROTON CROSS-SECTION FOR O^{16} (THRESHOLD TO 45 Mev). Internal Report. R. C. Morrison, J. R. Stewart, and J. S. O'Connell (Yale Univ., New Haven. Electron Accelerator Lab.). Jan. 1964. Contract AT(30-1)-1349. 12p.

From American Physical Society Annual Meeting, New York, Jan. 1964.

The nuclear reactions $^{16}O(\gamma,p)^{15}N$ and $^{12}C(\gamma,p)^{11}B$ were studied for proton energies of 500 kev to 25 Mev, using a bremsstrahlung beam produced by an electron linac. Photoprotons at 90° (lab) were focused by a quadrupole triplet and counted with semiconductor detectors. Proton energy resolution of the order of 150 kev was obtained, and absolute cross sections (assuming ground-state transitions) were measured by alternating the target with a deuterium sample and normalizing the data to the theoretical $^2H(\gamma,p)n$ cross section. (auth)

21164 (CONF-481-36) SPINS OF NEUTRON RESONANCES AND THE HYPERFINE FIELD IN GADOLINIUM METAL. F. J. Shore, V. L. Sailor, G. Brunhart, and C. A. Reynolds (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 14p.

From the American Physical Society, Annual Meeting, New York, Jan. 1964.

A method is described for the absolute determination of spins independent of any knowledge of the signs of magnetic moments and magnetic fields. The method consists of transmission measurements of polarized neutrons through polarized nuclei. Results are presented for ^{157}Gd. (P.C.H.)

21165 (CONF-490-1) THEORETICAL CALCULATION OF (n,p) CROSS SECTIONS. Charles L. Dunford, Norman C. Francis, C. R. Lubitz (Knolls Atomic Power Lab., Schenectady, N. Y.), and Jacob Rapaport (Massachusetts Inst. of Tech., Cambridge). [Oct. 1963]. Contract [W-31-109-eng-52]. 29p.

From the American Physical Society Fall Meeting, Gatlinburg, Tenn., Oct. 1963.

The cross section for the $^{58}Ni(n,p)^{58}Co$ reaction was calculated using Hauser's description of compound nuclear formation. In addition to the two known proton levels of ^{58}Co, two other levels were used. The effects of the levels and the optical model parameters (given) on the cross section were studied. The model was then used to calculate the cross sections for the (n,p) reaction on Zr, ^{39}K, and ^{16}O. The energy levels and optical model parameters used are tabulated, and the results are compared with experimental data. (D.C.W.)

21166 (CRRP-1183) FISSION RESONANCE INTEGRALS OF U-233, U-235, Pu-239, AND Pu-241. C. B. Bigham (Atomic Energy of Canada Ltd., Chalk River, Ont.). Feb. 1964. 26p. (AECL-1910)

The fission resonance integrals of ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu were measured relative to B, Li, and Au standards by fission counting. The fission resonance integrals of ^{233}U, ^{235}U, and ^{239}Pu were also measured relative to an In standard by the fission product gamma counting technique. Weighted averages of the fission resonance integrals above a 0.45 ev cut-off (including the 1/v contribution) obtained from this and other measurements are 761 ± 17, 277 ± 5, 324 ± 9, and 541 ± 14 barns for ^{233}U, ^{235}U, ^{239}Pu, and ^{241}Pu, respectively. (auth)

21167 (CRRP-1191) EFFECTIVE CROSS SECTIONS FOR U-235 AND Pu-239. E. Critoph (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1964. 5p. (AECL-1101(Add.))

Values of σ_a, σ_f, σ_c, α, ν, and η recommended as replacements for Westcott's values given in AECL-1101 are presented. The values, for well-moderated thermal reactor spectra, are based on more recent information. Revised values of g and s are also included. (D.C.W.)

21168 (GEMP-223) NINE- AND SIXTEEN-GROUP CROSS SECTIONS FOR TUNGSTEN. J. W. Zwick and A. Prince (General Electric Co. Advanced Technology Services, Cincinnati). June 3, 1963. Contract AT(40-1)-2847. 31p.

Revised neutron cross sections of natural tungsten are presented in the nine- and sixteen-group formats for use in transport theory codes S-VIII, S-X, S-XI, and TDC reactor nuclear calculations. The method employed in processing of the cross sections is outlined. The source of data are summarized, and a tabulation of cross section point-values for use in other calculations is included. (auth)

21169 (GEMP-278) GAMMA RAY PRODUCTION CROSS SECTIONS. W. E. Edwards (General Electric Co. Advanced Technology Services, Cincinnati). Apr. 7, 1964. Contract AT(40-1)-2847. 36p.

Gamma production cross sections are presented as a function of 16 neutron lethargy groups and 11 photon energy groups for 13 elements and isotopes. They were computed by the program GAMMA-P and account for the production of gamma rays by neutron radiative capture, neutron inelastic scattering, neutron induced fissioning, and (n,α) reactions. (auth)

21170 (GEMP-279) NEUTRON CROSS SECTIONS FOR TANTALUM IN THE NINE-ENERGY-GROUP FORMAT. J. W. Zwick (General Electric Co. Advanced Technology Services, Cincinnati). Apr. 6, 1964. Contract AT(40-1)-2847. 5p.

Neutron microscopic cross sections for tantalum are presented in the nine-group format. (auth)

21171 (INSJ-68) NUMERICAL DIFFERENTIAL CROSS SECTIONS OF ELASTIC SCATTERING OF PROTONS FROM Cu^{63} AND Cu^{65} IN THE ENERGY RANGE FROM 7.54 Mev TO 14.64 Mev. Masahiro Koike, Takashi Maki, Kazuhisa Matsuda, Takashi Mikumo, Yukio Nagahara, Itaru Nonaka, Arta Suzuki, and Ken Kikuchi (Tokyo Univ. Inst. for Nuclear Study). Feb. 13, 1964. 10p.

The differential cross sections were measured at about every 200 and 800 kev. ^{63}Cu and ^{65}Cu targets of 1 and 1.33 mg/cm^2, respectively, in thickness were used, and the scattered protons were detected by scintillation counters with NaI(Tl) crystals. The cross sections are tabulated as functions of angle and energy. (D.C.W.)

21172 (JINR-E-1561) STUDY OF THE OCTUPOLE STATES OF EVEN-EVEN STRONGLY DEFORMED NUCLEI. V. G. Solov'ev, P. Vogel, and A. A. Korneichuk (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 38p.

Octupole states of even-even nuclei with $\lambda = 3$, $\mu = 0, 1, 2, 3$ in the regions $150 \leq A \leq 186$ and $228 \leq A \leq 254$ are systematically investigated. The energies of states are calculated, and the structure is studied. Comparison with experimental data is made. (auth)

21173 (JINR-P-1479) NOVYE DANNYE O NEITRONODEFITSITHYX IZOTOPAKH Tm^{164}, Ho^{155}, Dy^{155}. MATERIALY VI SOVESHCHANIYA PO YDERNOI SPEKTROSKOPII NEITROVODEFITSITHYKH IZOTOPOV I TEORII YADRA. (New Data on Neutron-Deficient Tm^{164}, Ho^{155}, and Dy^{155} Isotopes. Reports of the IVth Conference on Nuclear Spectroscopy of Neutron Deficient Isotopes and Nuclear Theory). (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1963. 40p.

Three papers from the conference are included; separate abstracts have been prepared for each. (R.V.J.)

For abstracts of individual papers see: 21174, 21175, and 21176.

21174 (JINR-P-1479(p.3-25)) ISSLEDOVANIE SKHEMY RASPADA $Tm^{164} \xrightarrow[\epsilon_1\beta^+]{.2\ min} Er^{164}$. (Investigation of Decay Scheme $Tm^{164} \xrightarrow[\epsilon_1\beta^+]{.2\ min} Er^{164}$). A. S. Basina, K. Ya. Gromov, B. S. Dzhelepov, Ku Tsa Hek, and V. A. Morozov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems).

A device consisting of γ and β spectrometers with a fast-slow coincidence scheme and $2\tau = 8 \times 10^{-8}$ sec resolving time was used for verifying ^{164}Tm decay scheme and investigating e-γ coincidences and γ spectra at 500 to 3500 kev. Due to the short half life of ^{164}Tm ($T_{1/2}$ = 2 min) the studies of $^{164}Tm \rightarrow {}^{164}Er$ were carried out with a ^{164}Yb preparation in which ^{164}Tm is in equilibrium with ^{164}Yb ($T_{1/2}$ = 75 min). (R.V.J.)

21175 (JINR-P-1479(p.26-34)) O RASPADE Ho^{155}. (On the Decay of Ho^{155}). E. P. Grigor'ev, K. Ya. Gromov, and V. G. Kalinnikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems).

A double-focusing β spectrometer with 0.15% resolving power was used for measuring L_1, L_2, and L_3 transition lines at 39.55 kev in $^{155}Ho \rightarrow {}^{155}Dy$ decay. The ratio $L_1 : L_2 : L_3$ was $(1.55 \pm 0.10) : (0.92 \pm 0.05) : 1$. It was found that at 39.5 kev the transition is mixed with M1 + E2 multiplicity with $\delta^2 = 0.044 \pm 0.011$. The $T_{1/2}$ of $^{155}Ho \rightarrow {}^{155}Dy$ is 10 hrs. The decay $^{155}Dy \rightarrow {}^{155}Tb$ produced γ spectra with highest transition intensity at 227 kev and E1 multiplicity. Measurements on ^{155}Dy K-conversion at 227 kev were used for determining the number of L-conversion electrons of ^{155}Ho per decay. (R.V.J.)

21176 (JINR-P-1479(p.35-9)) ISSLEDOVANIE POZITRONNOGO SPEKTRA Dy^{155}. (On the Decay of Dy^{155}). E. P. Grigor'ev, K. Ya. Gromov, and V. G. Kalinnikov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems).

A triple-focusing β spectrometer using a double counter with double coincidences and 1.7% resolving power was used for determining the ratio of the number of positrons to the number of electrons in K-conversion at 227 kev. The ^{155}Dy β^+ spectrum at 850 kev and K-conversion at 227 kev showed the ratio $S_{\beta^+}860/S_K227 = 0.82 + 0.10$. The coincidence of positrons with 230-kev γ rays was measured with a fast-slow β-γ coincidence ($2\tau = 7.9 \times 10^{-8}$ sec) spectrometer. A γ spectrometer revealed a peak energy of 227 kev. The intensity of observed coincidences β^+ (400 kev) + γ 227 indicated that ^{155}Dy (70 ± 30)% β decay takes place at the 227-kev ^{155}Tb level. The results confirmed data presented by Ya. Urbanetz et al. (p.1178, Dubna, 1962) stating that 850-kev β decay takes place at the 227-kev level of ^{155}Tb with log ft = 6.3 ± 0.2. (R.V.J.)

21177 (JINR-P-1563) MNOGOKRATNOE KYLONOVSKOE VOZBYZHDENIE VRASHCHATEL'NYKH SOSTOYANII NEAKSIAL'NOGO CHETNO-CHETNOGO ATOMNOGO YADRA. (Multiple Coulomb Excitation of the Rotational States of a Non-Axial Even-Even Atomic Nucleus). V. V. Pashkevich (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 19p.

The dependence is investigated of the differential and total cross section for the multiple Coulomb excitation of even-even nuclei on the parameter γ which characterizes the non-axial shape of the nuclear surface. The results permit the determination of γ by measurement of the excitation cross section for the spin-2 second level if the experiment was carried out under conditions that permit application of the sudden approximation. (auth)

21178 (JINR-P-1568) ENERGII CHETNO-CHETNYKH SIL'NO DEFORMIROVANIIYKH YADER V OBLASTI $228 \leq A \leq 254$. (Energies of Even-Even Strongly Deformed Nuclei in the Region $228 \leq A \leq 254$). V. G. Soloviev and T. Shiklosh (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 18p.

The energies of the two-quasiparticle excited states of even-even nuclei in the range $228 \leq A \leq 254$ were calculated. The obtained energies of some collective nonrotational excited states and those of two-quasi-particle neu-

tron and proton states up to 2 Mev are tabulated. Data on the structures of gamma vibrational and octupole states are given. The states that must be displayed as two-quasiparticle and those take part in the formation of collective states are indicated. (auth)

21179 (JINR-P-1573) RASCHETY SVOISTV YADER REDKOZEMEL'NYKH ELEMENTOV PRI POMOSHCHI ULUCHSHENNOI TEORII PARNYKH KORRELYATSII. (Calculations of Properties of Rare Earths by Using a Refined Theory of Pairing Correlations). E. M. Bang and I. N. Mikhailov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 17p.

An approximate method is developed for calculation of matrix elements with functions of the type $\Psi = [\Sigma_s \phi_s a_{s+}^{+} a_{s-}^{+}]^{N/2} | 0 >$. The method is used for evaluation of the characteristics of the rare earth nuclei. It is shown that u, v transformation method with blocking leads to the correct results for the energy spectrum of nuclei. However, the properties of the eigenfunctions describing excited states change essentially, the more exact treatment of the conservation law of the nucleon number being applied. In particular, the pairing correlations turn out not to be so much damped in excited states of nuclei, as it is prescribed by the u, v-transformation method. (auth)

21180 (JINR-P-1574) VOZBUZHDENNYE SOSTOYANIYA NEAKSIAL'NYKH NECHETNYKH ATOMNYKH YADER. (Excited States of Non-Axial Odd-Mass Atomic Nuclei). V. V. Pashkevich and R. A. Sardaryan (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 25p.

The sequence of the spins and energies of the excited states of odd-mass deformed nuclei are calculated without differentiating between one-particle and collective excitations. The results of the theory are compared with experiments. (auth)

21181 (JINR-P-1575) K VOPROSU O NEUPRUGOM RASSEYANII POLYARIZOVANNYKH ELEKTRONOV NA YADRAKH. (On Inelastic Scattering of Polarized Electrons on Nuclei). I. Zh. Petkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 6p.

A formula was obtained for the differential inelastic scattering cross section for longitudinally polarized electrons on oriented nuclei. It is shown that in some cases the individual matrix elements can be expressed in terms of the experimentally measurable quantities. The matrix element corresponding to the M1 nuclear transition between the states $1/2^+ - 1/2^+$ is directly related to the experimental quantities. (auth)

21182 (JINR-P-1579) ENERGIYA SVYAZI GIPERTRITIYA V SLUCHAE NELOKAL'NOGO VZAIMODEISTVIYA. (The Hypertritium Binding Energy in Case of Nonlocal Interaction). I. Sh. Vashakidze and G. A. Chilashvili (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 10p.

The $_{\Lambda}H^3$ binding energy is calculated in the case of the nonlocal, but separable, potential. The global symmetry hypothesis is applied, and account is taken of $\Lambda N \rightleftharpoons \Sigma N$ transitions. (auth)

21183 (JINR-P-1580) O SPONTANNOM DELENII IZOTOPA 102-GO ELEMENTA S MASSOVYM CHISLOM 256. (On Spontaneous Fission of Element 102 Isotope With Mass Number 256). V. A. Druin, N. K. Skobelev, B. V. Fefilov, and G. N. Flerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1964. 12p.

Uranium-238 on a sloping target was bombarded with an intensive flux of neon-22 ions in the internal beam of the 310-cm cyclotron. Using the semiconductor counters the spontaneous-fission fragments were recorded. The effect observed is accounted for by the radioactive decay of the 102^{256} isotope produced in the reaction $U^{238}(Ne^{22},4n)102^{256}$. The spontaneous-fission half life T_{sf} of 102^{256} was found to be 1500 s. (auth)

21184 (JINR-P-1583) SYSHCHESYVUET LI MIR OCHEN STRANNYKH YADER? (Does There Exist a World of Very Strange Nuclei?). V. I. Ogievetskii and Ting-chang Hsien (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 8p.

The question concerning the existence and properties of nuclei with a very large strangeness is raised. The extention of unitary symmetry to nuclei leads to a conclusion that very strange nuclei may possess colossal binding energies and their properties are therefore very strange indeed. In particular, it is not ruled out that their lifetime is longer than that of hyperons. (auth)

21185 (KR-64) ADVANCED COURSE ON NUCLEAR PHYSICS WITH THERMAL NEUTRONS. Organized by the Netherlands'-Norwegian Reactor School at Institutt for Atomenergi, Kjeller, Norway, September 16-17, 1963. (Norway. Institutt for Atomenergi, Kjeller). 504p.

Thirty-two lectures are presented from the course; separate abstracts have been prepared for 28. Four lectures were previously abstracted in NSA as 17: 36152, 17: 36153, 17: 36658, and 17: 36659. (T.F.H.)

For abstracts of individual papers see: 20331, 20332, 20333, 20334, 21125, 21126, 21127, 21128, 21129, 21130, 21186, 21187, 21188, 21189, 21190, 21191, 21192, 21193, 21194, 21195, 21196, 21197, 21198, 21199, 21200, 21201, 21202, and 21566.

21186 (KR-64(Sect.II)) INTRODUCTION TO FISSION PHYSICS. J. C. D. Milton (Atomic Energy of Canada Ltd., Chalk River, Ont.). 21p.

Lectures are presented on the low-energy binary fission of heavy nuclei. Models and theories, and their degree of success in explaining experimental results, are discussed. (T.F.H.)

21187 (KR-64(Sect.IV)) INTRODUCTION TO THE THEORY OF β DECAY. C. J. Christensen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). 14p.

An introduction to the phenomenological theory of beta decay is presented. (T.F.H.)

21188 (KR-64(Sect.V)) INTRODUCTION TO SHELL THEORY. K. Gjoetterud (Oslo. Universitet). 16p.

An introduction to the shell model of nuclei is presented with particular attention to the properties of magic and near-magic nuclei. (T.F.H.)

21189 (KR-64(Sect.VI)) INTRODUCTION TO THE COLLECTIVE MODEL OF ATOMIC NUCLEI. E. R. Marshalek (Aktiebolaget Atomenergi, Studsvik, Sweden). 30p.

Lectures are presented containing evidence for collective motion in nuclei, followed by a review of several collective nuclear models. (T.F.H.)

21190 (KR-64(Sect.VII)) THE STATISTICAL MODEL OF THE NUCLEUS. J. P. Bondorf (Nordisk Institut for Teoretisk Atomfysik, Copenhagen). 23p.

A review is given (in lecture form) of the statistical nuclear model, with attention to reaction, evaporation, and fission cross sections and their fluctuations. (T.F.H.)

21191 (KR-64(Sect.VIII)) RECENT DEVELOPMENTS IN THE COLLECTIVE MODEL. E. R. Marshalek (Aktiebolaget Atomenergi, Studsvik, Sweden). 23p.

Several applications of nonrelativistic field theory methods to the nuclear many-body problem are reviewed, including the superconductor model of the nucleus, the cranking model for collective rotations, and the time-dependent self-consistent-field method for collective vibrations. (T.F.H.)

21192 (KR-64(Sect.IX)) DISCUSSION OF THE POSSIBLE ORIGIN OF SPIN-ORBIT COUPLING IN NUCLEI. K. Gjoetterud (Oslo. Universitet). 7p.

The spin-orbit interaction in the shell model of the nucleus is studied, under the assumption that it arises from a spin-orbit coupling in the nucleon–nucleon interaction. (T.F.H.)

21193 (KR-64(Sect.XIV)) SYSTEMATICS OF GAMMA-RAY DECAY SCHEMES FROM NEUTRON CAPTURE. H. Motz (Los Alamos Scientific Lab., N. Mex.). 6p.

The analysis of gamma spectra from thermal neutron capture reactions is studied. The results for a number of nuclei are tabulated. (T.F.H.)

21194 (KR-64(Sect.XV)) LATEST THEORIES ON FISSION. J. C. D. Milton (Atomic Energy of Canada Ltd., Chalk River, Ont.). 38p.

Lectures are given on the theory of fission, touching on the liquid-drop nuclear model, potential-energy mapping, effects of shell structure, prompt mass distributions, and kinetic energy distributions. (T.F.H.)

21195 (KR-64(Sect.XVI)) THE DISTRIBUTION OF NUCLEAR CHARGE IN FISSION. A. C. Pappas (Oslo. Universitet). 6p.

The relation between charge and mass distributions in thermal-neutron-induced fission is studied. (T.F.H.)

21196 (KR-64(Sect.XVII)) DELAYED NEUTRONS IN FISSION. A. C. Pappas (Oslo. Universitet). 5p.

A review is presented of theoretical and experimental studies of delayed neutron emission in nuclear fission. (T.F.H.)

21197 (KR-64(Sect.XVIII)) FISSION EXPERIMENTS. J. C. D. Milton (Atomic Energy of Canada Ltd., Chalk River, Ont.). 27p.

A review is given, in lecture form, of experimental results on nuclear fission. Particular attention is devoted to prompt neutron distributions and neutron emission by individual fission fragments. (T.F.H.)

21198 (KR-64(Sect.XIX)) ENERGY AND ANGULAR DISTRIBUTIONS OF PROMPT NEUTRONS FROM SLOW NEUTRON FISSION OF U^{235}. K. Skarsvåg (Norway. Institutt for Atomenergi, Kjeller). 20p.

An experiment is described whose purpose is the measurement of the energy and angular distributions of prompt neutrons from the thermal-neutron-induced fission of ^{235}U. (T.F.H.)

21199 (KR-64(Sect.XXI)) ANGULAR CORRELATION OF CAPTURE GAMMA-RAYS AFTER THERMAL NEUTRON CAPTURE. K. Abrahams (Reactor Centrum Nederland, [The Hague] and Norway. Institutt for Atomenergi, Kjeller). 11p.

A review is presented of the experimental and theoretical aspects of gamma-gamma angular correlations following thermal-neutron capture by nuclei. (T.F.H.)

21200 (KR-64(Sect.XXII)) THE CIRCULAR POLARIZATION OF CAPTURE GAMMA-RAYS OBTAINED AFTER CAPTURE OF POLARIZED NEUTRONS. K. Abrahams (Reactor Centrum Nederland, [The Hague] and Norway. Institutt for Atomenergi, Kjeller). 10p.

Experimental techniques for measurement of the circular polarization of gamma photons produced by the capture of polarized neutrons are reviewed. These measurements are performed in order to determine the spins of the excited states of the residual nucleus and multipole mixing parameters of transitions between various excited states. (T.F.H.)

21201 (KR-64(Sect.XXVIII)) BETA DECAY AFTER CAPTURE OF POLARIZED NEUTRONS. H. Postma (Leiden. Universiteit). 7p.

Nuclear polarization produced by the absorption of polarized neutrons, and the effects of the emission of capture gamma rays on this nuclear polarization, are studied. The asymmetry of beta particles emitted by these polarized nuclei is studied, taking into account nuclear depolarization via recoil and relaxation. The use of this method in conjunction with a nuclear resonance technique, to determine the spin and gyromagnetic ratio of the beta-emitting nucleus, is discussed. Experimental results are tabulated. (T.F.H.)

21202 (KR-64(Sect.XXXII)) PRACTICAL METHODS FOR DECOMPOSING γ-RAY SPECTRA, AND FOR DETERMINING SPINS OF LEVELS, IF THE EXPERIMENTAL DATA ARE GIVEN. R. Nordhagen (Oslo. Universitet). 14p.

Two techniques are described — one for decomposing measured gamma spectra into their components, and the other for comparing the results of gamma-ray correlation experiments with theoretical predictions. The techniques are developed for use with proton capture experiments, but are applicable to neutron-capture studies. (T.F.H.)

21203 (LA-1493) TOTAL NEUTRON CROSS SECTIONS FOR U^{235}, NORMAL URANIUM, Pu^{239}. R. L. Henkel (Los Alamos Scientific Lab., N. Mex.). Nov. 20, 1952. Contract W-7405-eng-36. 10p.

The total neutron cross sections for natural uranium, ^{235}U, and ^{239}Pu were measured as a continuous function of energy for neutron energies between 40 and 7500 kev. Three additional measurements were made between 17 and 20 Mev. The data were obtained from a transmission experiment in which 1-in.-diameter cylindrical samples were interposed midway between a neutron source and a neutron counter spaced at about 20 in. separation. In general, the statistical errors were within ± 0.2 barn. The total cross section curves are almost identical for the three materials and very similar to those of other heavy elements. This suggests that the total neutron cross section for other heavy elements can be predicted with some accuracy. (auth)

21204 (LADC-6302) COMPLEX SINGLE-NUCLEON STRIPPING AND PICKUP REACTIONS (α,t), (d,He^3), ETC. Allen G. Blair (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 32p. (CONF-396-6)

From Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Mar. 1964.

The use of the stripping reactions (^{3}He,d), (α,t) and (α,^{3}He) and the inverse pickup reactions for level structure studies is considered, particularly the analysis of these reactions. Some plane-wave and distorted-wave analyses, mainly for the (d,^{3}He) and (^{3}He,d) reactions, are reviewed. (D.C.W.)

21205 (NP-13807) THE NUCLEAR PROPERTIES OF RHENIUM. Final Technical Report. E. E. Menge, W. H. Ellis, R. A. Karam, and T. F. Parkinson (Florida. Univ., Gainesville). Dec. 1963. Contract NOas-60-6021-c. 15p.

Addendum to final report AD-402668.

The energy and intensity of the capture gamma transitions of natural rhenium were determined with a NaI(Tl) scintillation detector using a neutron-gamma beam from the thermal column of the University of Florida Training Reactor. The results obtained agreed rather well with those reported by other experimenters who used different techniques. (auth)

21206 (NP-13813) THE WIDTH OF GIANT RESONANCES IN HEAVY NUCLEI. Technical Report No. 354. Michael Danos (National Bureau of Standards, Washington, D. C.) and Walter Greiner (Maryland. Univ., College Park). Feb. 1964. 50p.

The damping of giant resonances in heavy nuclei is due to the thermalization of the energy, which proceeds via inelastic collisions leading from the particle-hole state to the two-particle two-hole state. First order perturbation theory is used to calculate the transition probability of inelastic collisions and thus the width of the giant resonance. The features of the damping mechanism are described in detail. Both the density of the two-particle two-hole states and the mean value of the matrix elements are evaluated in a simplified square well shell model. The energy dependence of the width, which is determined mainly by the density of states, is expressed by a power law and the value obtained for the exponent is ~ 1.8. The A-dependence is determined mainly by the size of the matrix elements. For $A \approx 200$, $1 \text{ Mev} \leq \Gamma \leq 5 \text{ Mev}$ was found. (L.B.S.)

21207 (NP-13839) CONTRIBUTION A L'ETUDE DES INTERACTIONS NUCLEAIRES DE PLUSIEURS DIZAINES DE Gev., AU MOYEN DES RAYONS COSMIQUES (THESES). (Contribution to the Study of Nuclear Interactions at Several Tens of Bev by Means of Cosmic Radiations (thesis)). Claude Pelletier (Paris. Université). 1960. 145p.

The secondaries produced by the interaction of high-energy cosmic radiation with aluminum were studied with Wilson chambers placed in a magnetic field. From 9600 photographs made, 117 interactions of charged particles with energy higher than 10 Bev in aluminum were selected. These photographs were obtained with the apparatus installed at the Observatory of the Pic du Midi de Bigorre. This apparatus is described. The quantities of motion and the emission direction of charged secondaries of each interaction were determined. The measurements and the methods of calculation are described. The results obtained on charged secondaries and unstable particles are reported. The selection of the interactions which occurred with only one nucleon of the aluminum nucleus is discussed. These interactions were studied in the center-of-mass system of the interacting particles. The results obtained are compared with the predictions of the principal theoretical models of nucleon-nucleon interactions. (tr-auth)

21208 (NP-13841) ÉTUDE DES SPINS ET PARITÉS DE NIVEAUX EXCITÉS DE NOYAUX PAR DES MÉTHODES D'ORIENTATION AUX BASSES TEMPERATURES, DE CORRÉLATIONS ANGULAIRES ET DE CORRÉLATIONS DIRECTION-POLARISATION (theses). (Study of the Spins and Parities of Excited Levels of Nuclei by Methods of Low-Temperature Orientation, Angular Correlations, and Direction-Polarization Correlations (thesis)). Jean-Paul Perez y Jorba (Paris. Université, Orsay). 1960. 108p.

The methods of Bleaney and Gorter-Rose were used to orient at low temperatures several radioactive nuclei. The orientation was detected by measurement of the anisotropy and the polarization of the γ rays emitted. The character of the first excited state of ^{54}Cr was established as 2+, and the γ radiation emitted by this state was electric quadrupole. It was shown that the K capture by which this state decays to the ground state of ^{54}Mn corresponds to an allowed Fermi transition. The alignment of ^{57}Co furnished an effect of zero anisotropy, but a polarization effect different from 0. This established that the 123-kev radiation corresponds to an M_1E_2 mixture with a mixing coefficient of 0.19 ± 0.02. In the decay of ^{147}Nd, the $^7/_2$+ character of the 92-kev level was verified. It was shown that the 530-kev level was also a $^7/_2$+ level. The two rays correspond to M_1 and E_2 mixtures. The mixing coefficients and the magnetic moment of ^{147}Nd were also determined. The 145-kev ray emitted in the decay of ^{141}Ce also corresponds to an M_1E_2 mixture. It was not possible to choose between the possibilities $j = 0$ and $j = 1$ for the angular moment for the corresponding β transition. The hyperfine structure constant A and the magnetic moment μ of ^{141}Ce were determined for both cases. Radioactive nuclei were also studied by angular correlation and direction-polarization correlation methods. The 2+ and 3− character of the first and second excited states of ^{88}Sr was verified. It was shown that the 910-kev γ transition corresponded to an E_1M_2 mixture. The decay scheme of ^{140}La was studied by the same methods. The intensity of the principal γ radiations was measured. The first three excited states of ^{140}Ce were determined as 2+, 4+, and 3+. The 815-kev radiation corresponded to an M_1E_2 mixture. An upper limit of 6×10^{-10} sec was established, using delayed coincidence methods, for the mean lifetime of the 530-kev excited state of ^{147}Pm. (tr-auth)

21209 (NP-13842) ETUDE EXPÉRIMENTALE DES INTÉRACTIONS NUCLÉAIRES DE HAUTE ÉNERGIE DANS LE RAYONNEMENT COSMIQUE (THÈSES). (Experimental Study of High-Energy Nuclear Interactions in Cosmic Radiation (thesis)). Lucien Montanet (Paris. Université). 1960. 55p.

The theoretical and experimental data on high-energy nuclear interactions are briefly reviewed. The experimental conditions used for the study of primary energies of the order of 100 Bev and the characteristics of the Wilson chamber used and its magnetic field are reported. The methods used for the selection and measurement of events are described. Measurements made in the laboratory system on jet multiplicity, the nature of the particles, and the distribution of the transverse pulse are given. The results obtained in the center-of-mass system on incident energy, angular distribution, energy spectra, and inelasticity are then reported. The nature of the interactions are analyzed, and the results are analyzed using models currently accepted for this type of interaction. (J.S.R.)

21210 (PAN-288) THE (d,^{3}He) REACTION OF SULPHUR NUCLEI. A. Budzanowski, F. Pellegrini, and S. Wiktor (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Sept. 1963. 12p.

The angular distributions of ^{3}He particles from the ^{32}S(d,^{3}He)^{31}P reaction, leading to the ground, first and second excited states of ^{31}P were measured at a deuteron energy of 12.8 Mev. A comparison with the plane wave Butler theory indicates the existence of Coulomb distor-

tion effects. The extracted reduced widths are compared with the predictions of the shell model and the Nilsson model. The relative spectroscopic factor for the first excited state of ^{31}P may be explained in terms of band mixing with $K = 3/2$ and $K = 1/2$. The second excited state seems to be a rotational state built on the ground state configuration. (auth)

21211 (PAN-299) MAGNETIC INTERACTION OF THE ^{155}Gd NUCLEUS IN THE 87-kev EXCITED STATE WITH THE ELECTRONIC SHELL. E. Bozek, A. Z. Hrynkiewicz, S. Ogaza, and J. Styczen (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Nov. 1963. 12p.

The influence of longitudinal and transverse magnetic fields on the angular correlation of the gamma-gamma cascade (182 + 180) – 87 kev in ^{155}Gd was investigated. It was found that the hfs-interaction of the 87-kev nuclear state of ^{155}Gd with the Gd^{3+}-ion electronic shell is completely decoupled in strong transverse magnetic fields. From the measured lifetime of the investigated nuclear state $T_{1/2} = (6.68 \pm 0.12)$ nsec and from the value of the attenuation coefficients of the angular correlation in strong transverse magnetic field the hfs-constant $a = 20.6^{+3.6}_{-2.8}$ MHz for the 87-kev state of ^{155}Gd was determined, hence the nuclear g-factor of this state $g = 0.28^{+0.05}_{-0.04}$ could be calculated. (auth)

21212 (PAN-445/VI) TABLE OF ANGULAR MOMENTUM WEIGHT FACTORS $\tilde{j}_{n+1}(l_1, \ldots, l_n, L)$. Michal Majewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Sept. 1963. 22p.

The weight factors are defined, and the method used to evaluate them is described. Use of the table to calculate weight factors when some of the arguments are half-integer is also demonstrated. (D.C.W.)

21213 (TID-20440) INFORMATION RELEVANT TO THE CHOICE OF THE PRIMARY PROTON ENERGY FOR A MESON FACTORY. Yale Study on High Intensity Proton Accelerators. R. D. Edge, V. W. Hughes, H. B. Knowles, and S. Ohnuma (Yale Univ., New Haven). Mar. 16, 1964. Contract [AT(30-1)-1349]. 27p. (Y-8)

Threshold energies, particularly for p-N interactions involving a single pion, are given, together with cross sections and spectra for pion production. Information on the intensities and energy spectra of secondary beams is also included. The desirability of certain primary proton energies is then discussed. (D.C.W.)

21214 (UCRL-10630(Rev.)) THE INFLUENCE OF HIGH PRESSURES ON THE MÖSSBAUER EFFECT IN DYSPROSIUM-161. J. A. Stone, M. Nicol, G. Jura, and J. O. Rasmussen (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Apr. 1963. Contract W-7405-eng-48. 31p.

Nuclear resonance absorption of the 25.6-kev gamma ray of ^{161}Dy was studied experimentally at pressures up to 100 kbar by using sources situated in gadolinium metal together with thin metallic dysprosium absorbers. Velocity spectra taken at 30 and 50 kbar show complex hyperfine structure. Increasing the pressure leads to both greater recoil-free fractions and greater overall hyperfine splitting. The effect of pressure on the recoil-free fraction is satisfactorily explained with a modification of Hanks' theoretical treatment. It is proposed that the hyperfine splitting is predominantly due to electric quadrupole interactions, with the electric field gradient at the nucleus increasing with increasing pressure. By fitting theoretical spectra to the velocity spectrum at 30 kbar, a value of 1.30 is derived for the ratio of the quadrupole moments of the 2.56-kev state and the ground state of ^{161}Dy. (auth)

21215 (UJV-1002-63) THE 4-PARTICLE WAVE FUNCTION IN THE SU_3 SCHEME. L. Trlifaj (Československá Akademie Věd. Ustav Jaderného Výzkumu, Rež). [1962]. 9p.

The construction of the 4-particle wave functions in the s-d nuclear shell, which are labelled by the partition (22) of the unitary group SU_6 (and of the permutation group), by the partitions (42), (04), (20) of the SU_3 group, and by the angular momenta $S = L = J = 0$, is demonstrated. The Young operator and spherical tensor technique is used. The pairing in these wave functions is calculated. (auth)

21216 STUDY OF THE PAIRING FORCE AND SOME APPROXIMATION METHODS USED IN NUCLEAR SPECTROSCOPY. Jacqueline Hogasen (Faculté des Sciences, Paris). Ann. Phys. (Paris) (13), 8: 697-721(Sept.-Oct. 1963). (In French)

The general properties of the pairing force are established, and the different approximation methods, including those for interactions between quasiparticles, are reviewed. The validity of the approximations is examined by comparison with exact results. Applications to nuclear physics are then considered. The 0^+ first excited levels of doubly magic nuclei, nuclei with one complete shell (^{89}Y, ^{90}Zr, and ^{91}Nb), and deformed nuclei are treated. (D.C.W.)

21217 CROSS SECTIONS FOR THE EXCITATION OF LEVELS OF Mg, ^{52}Cr, ^{58}Ni, ^{60}Ni, AND ^{93}Nb FROM THE INELASTIC SCATTERING OF NEUTRONS. D. L. Broder, V. E. Kolesov, A. I. Lashuk, I. P. Sadokhin, and A. G. Dovbenko. At. Energ. (USSR), 16: 103-10(Feb. 1964). (In Russian)

The cross sections for the excitation of several levels of nuclides by 1 to 4 Mev neutrons were measured; the results are compared with the results of machine calculations using the optical model of the nucleus with the complex Woods-Saxon potential. The $^3H(p,n)^3He$ reaction was used for $E_n < 3$ Mev (±30 kev); and the $^2H(d,n)^3He$ reaction for $E_n > 3$ Mev (±80 kev). Gamma rays were detected with a 40 × 40 mm NaI(Tl) scintillator. The cross sections were normalized to 0.53 b for the excitation of the 0.84-Mev γ ray in ^{56}Fe (99% enriched) by 1.2 Mev neutrons. The error in the γ intensities was 15 to 25%. Calculations of the cross sections for the excitation of the first levels of the isotopes of Mg (1.37 Mev for ^{24}Mg, 1.6 Mev for ^{25}Mg, and 1.83 Mev for ^{26}Mg) agreed well with experimental results. The 1.61-Mev level in ^{25}Mg gave a better fit for spin and parity $7/2^+$ than for $5/2^+$. ^{52}Cr had its first two levels at 1.46 and 2.43 Mev (4+ and 2+, $E_\gamma = 1.45$ and 0.94 Mev). Decay of the upper levels of ^{58}Ni cascaded through the first level (1.452 Mev); comparison of calculated and experimental results was not good enough to determine whether the 2nd level (2.458 Mev) was 4+ or 2+. The energy (in Mev), spin, and parity of the 1st 5 levels of ^{60}Ni were determined to be 1.332 (2+), 2.158 (2+), 2.502 (4+), 2.672 (2+), and 3.130 (2+). The level scheme found for ^{93}Nb agreed with earlier published results. However, except for the 1.08 Mev level ($5/2^+$) no satisfactory determination of the spins and parities of the levels could be made. (TTT)

21218 THE CROSS SECTION OF THE $T(d,n)^4He$ AND $D(d,n)^3He$ REACTIONS IN THE DEUTERON ENERGY RANGE FROM 3 TO 19 Mev. O. D. Brill, V. M. Pankratov, V. P. Rudakov, and B. V. Rybakov. At. Energ. (USSR), 16: 141-3(Feb. 1964). (In Russian)

The $T(d,n)^4He$ and $D(d,n)^3He$ reactions are widely used as fast-neutron sources and therefore, in order to supplement

reported data concerning their cross sections in the 12- to 14-Mev range, the value of their differential cross sections under an angle of 0° at deuteron energies ranging from 3 to 19 Mev was determined, using the extracted beam of the 1.5-m cyclotron of the Kurchatov Institute for the measurements. The cyclotron was operated at deuteron energies of 10 and 20 Mev; deuterons with lower energies were obtained by slowing down in Pt foils placed directly on the targets, consisting of solid Zr–T supported by W boats and of gaseous T. The time-of-flight type fast reactor spectrometer was used, determining simultaneously the pulse amplitude spectrum of the recoil protons in the stilbene crystal of the scintillation detector. The angular distribution curve of the neutrons was found to be strongly extended in the forward direction. Slowing down of the deuterons in the Pt foil caused scattering and widening of the maximum of the neutrons' angular distribution. The absolute cross section values of the D(d,n)^{4}He reaction, determined with an accuracy of ±10%, agreed well with previously published data. The corresponding values of the T(d,n) reaction were less accurate because the T content of the solid target is known only within ±30%. (TTT)

21219 THE PROBABILITY RATIO OF THE TERNARY FISSION OF URANIUM-235 AND URANIUM-238 BY NEUTRONS OF VARIOUS ENERGIES. L. V. Drapchinskii, S. S. Kovalenko, K. A. Petrzhak, and I. I. Tyutyugin. At. Energ. (USSR), 16: 144-5(Feb. 1964). (In Russian)

The dependence of the ternary fission probability on the excitation energy of the fissioning nucleus must be determined in order to clarify the mechanism of the process; tests were therefore carried out, using CsI(Tl) crystals for detecting the long-range α particles from the ^{235}U and ^{238}U targets under a body angle of 2π. Neutrons from the D(d,n)^{3}He and T(d,n)^{4}He reactions, with energies of 2.5 and 14 Mev, respectively, were used for the irradiation. The ternary fission events were identified by the α particle–fission fragment coincidence. The following probability ratios were obtained for the ternary fission: for ^{235}U W_{E_n} = 2.5 Mev/W_{slow} = 0.95 ± 0.08; W_{E_n} = 14 Mev/W_{slow} = 1.21 ± 0.17. The data indicated that within the limits of the experimental error, the probability of the ternary fission does not change in the case of fission by slow, 2.5, and 14-Mev neutrons. For the dependence of the ternary fission on the excitation energy, the values reported by R. Nobles (Phys. Rev., 126: 1508(1962)) were also taken into consideration; it was concluded that the probability of the ternary fission remains unchanged in the various binary fission channels. (TTT)

21220 THE ACTIVATION CROSS SECTION OF ^{108}Cd BY THERMAL NEUTRONS. A. G. Beda, L. N. Kondrat'ev, and E. F. Tret'yakov. At. Energ. (USSR), 16: 145-6(Feb. 1964). (In Russian)

The activation cross section of ^{108}Cd by thermal neutrons was determined by comparing the ^{109}Cd and ^{115}Cd activities, which are formed on irradiating a cadmium sample for 100 hours in a heavy water reactor. The content of ^{108}Cd in the cadmium sample was 49.8%. The ratio of ^{109}Cd to ^{115}Cd activities was found to be 1.17. The measurements were carried out on an iron-free β spectrometer 207 hours after the irradiation. Since the decay schemes of ^{109}Cd and ^{115}Cd are known, and the cross section for the formation of the metastable ^{115}Cd state is also known (q = 1.1 ± 0.3 barns), the results of three independent measurements gave a cross section of 2.7 ± 0.9 barns for the ^{108}Cd(n,γ)^{109}Cd reaction. The half life of the metastable ^{115}Cd state was found to be 53.8 ± 1.8 hours, a value in agreement with the literature value. The half life of ^{109}Cd was assumed to be 470 days in calculating the activation cross section of ^{108}Cd. (TTT)

21221 EVALUATION OF THE CONTRIBUTION OF IODINE AND BROMINE ISOTOPES IN THE PROCESS OF THE EMISSION OF DELAYED NEUTRONS. I. T. Krisyuk. At. Energ. (USSR), 16: 146-7(Feb. 1964). (In Russian)

The daughters of the delayed-neutron precursors ^{138}I and ^{139}I (^{138}Xe and ^{139}Xe) may decay under emission of both β particles and neutrons. If the branching coefficient is known, the contribution of a given isotope to the emitted delayed neutrons may be estimated. From published data it was estimated that the I isotopes (137, 138, and 139) do not yield more than 11% of the neutrons and not more than 4% of the delayed neutrons; the other I isotopes do not contribute hardly at all to the emission of delayed neutrons. For estimating the contribution of the Br isotopes, the known branching coefficient, 2%, of their decay process was used. Results of the calculation indicated that the number of neutrons attributable to the Br isotopes amounts to about 10% of the total delayed neutron yield, and in no case can it exceed 17%. Thus, the Br and I isotopes, which were considered the primary precursors of delayed neutrons, do not yield more than 20% of all the delayed neutrons. This may be explained by the fact that with the exception of ^{87}Br, none of the halide precursors possess a half life coinciding with the half life of a given group of delayed neutrons; quite probably, each such group has a large number of precursors. (TTT)

21222 THE SPONTANEOUS FISSION OF ^{244}Cm WITH EMISSION OF A LONG-RANGE α PARTICLE. L. Z. Malkin, I. D. Alkhazov, A. S. Krivokhatskii, K. A. Petrzhak, and L. M. Belov. At. Energ. (USSR), 16: 148-9(Feb. 1964). (In Russian)

The spontaneous fission fragments from ^{244}Cm were counted on a xenon scintillation detector, whose walls were covered with a layer of sodium salicylate to convert the ultraviolet emission of xenon to visible light. Long-range α particles were counted on a CsI crystal 0.8 mm thick. The ^{244}Cm was purified from rare earths by elution from a Dowex-50 column with 0.25M α-hydroxyisobutyrate at a pH of 4.0. The ^{244}Cm was mounted on an oxidized aluminum foil with a surface density of 7.1 mg/cm^2 to discriminate against the 6.15-Mev α particles of ^{244}Cm. The triple fission of ^{244}Cm was measured continuously for a period of 8 days. A total of 400 spontaneous fission events was recorded with emission of long-range α particles. One ternary fission occurred for each 318 ± 25 binary fissions. The most probable energy of the long-range α particle is 15.8 ± 1.1 Mev, and the maximum energy is 29.0 ± 1.9 Mev. The most probable energy is 100 Mev for the lighter fission fragment, and 77 Mev for the heavier fission fragment. (TTT)

21223 VELOCITY-DEPENDENT NUCLEON-NUCLEON POTENTIALS AND SATURATION IN NUCLEAR MATTER. R. K. Bhaduri and M. A. Preston (McMaster Univ., Hamilton, Ont., Can.). Can. J. Phys., 42: 696-719(Apr. 1964).

Recently, nonsingular velocity-dependent potentials which fit the two-nucleon data but do not give saturation in nuclear matter at reasonable densities were constructed. It is asked what features a potential should have in order to give saturation. The short-range wave-function distortion is found to be important. Reasons are given for the failure of the earlier potentials to saturate, and a new velocity-dependent potential is proposed which gives results similar to the standard hard-core potential model. The usefulness of such potentials for future calculations of nuclear properties is pondered. (auth)

21224 GAMMA–ALPHA REACTIONS IN THE LIGHT NUCLEI OF NUCLEAR EMULSIONS. L. H. Greenberg, J. P. Roalsvig, and R. N. H. Haslam (Univ. of Saskatchewan, Saskatoon). Can. J. Phys., 42: 731-61(Apr. 1964).

Ilford E.1 nuclear emulsions were loaded with various amounts of glycerine to vary the content of carbon and of oxygen and were then irradiated in the beam of the University of Saskatchewan betatron. The numbers of single alpha-particle tracks and of four-pronged alpha-particle stars were correlated to the oxygen content of the plates, and the number of three-pronged stars to the carbon content. The yields for the reactions $^{16}O(\gamma,\alpha)^{12}C$, $^{16}O(\gamma,4\alpha)$, and $^{12}C(\gamma,3\alpha)$ for bremsstrahlung of 24-Mev maximum energy were found without confusion with reactions in other nuclides of the emulsion and without having to rely on momentum balances for identification of the events. It was shown that the method of identification of $^{16}O(\gamma,\alpha)^{12}C$ events by the measurement of the track of the ^{12}C was not reliable. The large number of alpha tracks in the energy range 4 to 5 Mev, few of which showed a ^{12}C track, was shown to be due largely to reactions in ^{16}O. It was possible, by irradiating emulsions at 17- and at 24-Mev maximum bremsstrahlung energy, to find the energy levels in ^{16}O and in ^{12}C through which the reactions passed. (auth)

21225 ON THE NECESSITY OF AXIAL ASYMMETRY IN SOME NUCLEI. S. Das Gupta and M. R. Gunye (National Research Council of Canada, Chalk River, Ont.). Can. J. Phys., 42: 762-5(Apr. 1964). (AECL-1927)

It is pointed out that the relative positions of the second 2+ level and the first 4+ level in some nuclei suggest that they possess axially asymmetric equilibrium deformation. (auth)

21226 HYPERFINE STRUCTURE OF THE LEVEL $2^2P_{\frac{1}{2}}$ OF LITHIUM 7. George J. Ritter (National Research Council, Ottawa). Can. J. Phys., 42: 833(Apr. 1964). (NRC-7876)

An attempt was made to determine the hyperfine structure constants, a_j, for the $2^2P_{\frac{1}{2}}$ level of lithium-7. Resonances in the fluorescent radiation from a Li atomic beam irradiated by red r-f Li light were observed for frequencies from 22 to 100 Mc/s, with a magnetic field from 0 to 180 gauss. A value of $a_{\frac{1}{2}} = 46.0 \pm 1.0$ Mc/s was obtained. (M.J.T.)

21227 CONDITIONS OF THE POSITIVE β-DECAY (ENERGY RELATIONS AND FORBIDDEN CHARACTER). Denes Berenyi (Inst. for Atomic Research, Debrecen, Hungary). Fiz. Szemle, 13: 263-4(Sept. 1963). (In Hungarian)

In the case of β decay involving the emission of a positron a proton of the original nucleus is transformed into a neutron, emitting a positron and a neutrino. The emission of a positron in a process requires a suitable energy difference between the initial and the final states; decay takes place only if the mass of the nucleus before decay is larger than the mass after decay + 1 electron or a positron. Opinions were occasionally expressed in the literature that the β^+ decay requires more energy than the β^- type. The apparent difference is considered due to the fact that nuclide masses are used for practical reasons instead of the nuclear masses. The forbidden level of the transition is determined by the spin and the parity changes. A tabulation of the selection rules, defining the forbidden character, is presented. It is pointed out that in radioactive decay, positron may appear, under certain conditions, also in internal pair conversion and monoenergetic processes. (TTT)

21228 SHELL ELECTRON CAPTURE FROM VARIOUS ATOMIC SHELLS. Endre Vatai (Inst. for Atomic Research, Debrecen, Hungary). Fiz. Szemle, 13: 264-71(Sept. 1963). (In Hungarian)

Electron capture conditions were investigated and it appeared desirable to extend these studies to the field of forbidden transitions. The capture relations are considered of interest also for furthering the knowledge of decay schemes; in the case of low decay energy, information may be obtained on the transition energy or on the forbidden levels, which could not be acquired by other means. Measurement of the γ-x coincidences increased the number of events that could be examined by means of the capture relations because for highly excited levels the capture energy becomes small and may lie in the area of $E_\gamma = 2000$ kev. In the β decay process, one of the neutrons (protons) of the nucleus, which is in excess with respect to the amount required to form a stable system, is transformed into an electron (positron) and an antineutrino (neutrino). Within the nucleus, the transition of a proton into a neutron may take place by means of electron capture and the emission of a neutrino, if there is an electron in the vicinity of the nucleus. (TTT)

21229 ANGULAR CORRELATION OF FRAGMENTS AND LIGHT PARTICLES IN NUCLEAR FISSION. S. A. Azimov, R. Karimova, and O. V. Lozhkin (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 35-9(1963). (In Russian)

Nuclear emulsions were irradiated with 660-Mev protons and used in an investigation of proton and α angular correlations with fission fragments with $Z > 4$ to 9. Experimental angular distributions between the fragments and light particles were in good agreement with calculated values, showing an absence of an inherent angular correlation between fragments and light particles and indicating that in the process studied, low-excitation ($Z = 4$ to 9) fragments are emitted in Ag and Br spallation. (R.V.J.)

21230 FORMATION OF MULTIPLE FRAGMENTS AT INCIDENT PROTON ENERGY OF 660 Mev. S. A. Azimov, P. A. Gorichev, and R. Karimov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 40-5(1963). (In Russian)

Angular correlations of two $Z > 4$ fragments in 2 to 9 Bev incident proton fission indicate considerable dependence on fragment energies. The mechanism of dependence is different for different fragment pair energies. Two slow ($E <$ 5 Mev/nucleon) fragments are emitted simultaneously and one slow and one fast ($E >$ 5 Mev/nucleon) are emitted in 2 stages in fast particle reactions. After emitting the particles the nucleus may retain enough energy to evaporate several light particles. An hypothesis on simultaneous slow particle emission and two-stage emission of slow and fast fragments, angular correlation between two fragments, and prior emission of light particles was verified. (R.V.J.)

21231 ON THE THEORY OF EXCITED STATES OF ODD NUCLEI WITH SMALL NON-AXIALITY. Sh. Sharipov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz.-Mat. Nauk, No. 6, 58-62 (1963). (In Russian)

Excitation levels of nuclei with negative quadrupole moments and $\frac{5}{2}$ and $\frac{7}{2}$ spins were measured as functions of Z. Experiments with ^{131}I and ^{127}I showed intrinsic quadrupole moments of -0.35×10^{-24} cm^2 and $-(0.69 \pm 0.03) \times 10^{-24}$ cm^2, respectively. The data indicate that the excited states of odd nuclei with negative intrinsic quadrupole mo-

ments cannot be separated into one-particle rotation and excitation, as ordinarily interpreted, but must be interpreted as a complex combination of three types of excitations. (R.V.J.)

21232 MAGNETIC SHIELDING OF A NUCLEUS BY A NEIGHBORING ATOM. Jeremy I. Musher (Rockefeller Inst., New York). J. Chem. Phys., 40: 2399-2403(Apr. 15, 1964).

The Lamb term of the magnetic shielding of a nucleus was calculated for an electron on a neighboring atom in an s or a p state using Slater atomic wavefunctions. The exact calculation is presented in order to illustrate the radial dependence of long-range nuclear magnetic shielding and to point out explicitly for the wavefunctions the distance at which the dipole approximation introduces only a negligible error. (auth)

21233 NUCLEAR MAGNETIC SHIELDING CONSTANTS FOR TWO-, THREE-, AND FOUR-ELECTRON ATOMS AND IONS. Frank O. Ellison (Carnegie Inst. of Tech., Pittsburgh). J. Chem. Phys., 40: 2421-2(Apr. 15, 1964).

Values of nuclear magnetic shielding constants for two-, three-, and four-electron atoms and ions are compared and discussed. It was concluded that the error $\sigma_{NR} - \sigma_{HF} = \delta\sigma \sim 0$ for two- and three-electron systems, but $\delta\sigma > 0$ or $\sigma_{NR} > \sigma_{HF}$ for four-electron systems. (P.C.H.)

21234 DECAY OF ^{157}Eu. Yoshijirô Shida (Tokyo Univ.). J. Phys. Soc. Japan, 19: 245-8(Mar. 1964).

The beta decay of ^{157}Eu was investigated with a conventional scintillation spectrometer. Intense gamma rays were observed at energies of 65, 370, 410, and 620 kev with a half life of 15h. Five weaker gamma rays were also found. Beta-ray groups with maximum energies of 1.35, 1.28, 0.90, 0.87, 0.66, and 0.53 Mev were found from single and coincidence measurements. Decay energy is determined to be 1.35 Mev. From the analyses with the aid of Nilsson model, a tentative decay scheme of ^{157}Eu is proposed. (auth)

21235 NUCLEAR MOMENTS OF Yb^{173}. John S. Ross (Rollins Coll., Winter Park, Fla.) and Kiyoshi Murakawa. J. Phys. Soc. Japan, 19: 249-53(Mar. 1964).

The hyperfine structure of the spectrum of ytterbium was studied, using separated isotopes 171 and 173 as well as natural ytterbium. The nuclear moment ratio $\mu(171)/\mu(173) = -0.7248 \pm 0.0008$ was obtained; and from the known value of $\mu(171)$ the value $\mu(173) = -0.6802 \pm 0.0010$ nm was obtained. The nuclear quadrupole moment of ^{173}Yb deduced from the levels $6s6p\ ^3P_1$ and $^3P_2$ is 3.1 ± 0.2 b without shielding correction. The method of the calculation is discussed. (auth)

21236 INTERNAL PAIR PRODUCTION BY NEUTRON REACTIONS IN Cl^{35}. L. Meyer (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Nucl. Phys., 52: 213-20(Mar. 1964). (In German)

The angular distribution of electron-positon pairs emitted in the reaction $^{35}Cl(n,\gamma)^{36}Cl$ was investigated by means of a Wilson cloud chamber. A beam of thermal neutrons was passed diametrically through the chamber transversing the target foil at its center. Photographs were taken giving a yield of 334 electron-positon pairs acceptable for measurement. The angular distribution of 56 pairs due to the intensive line of 6.11 Mev seems to indicate an M1 character for this transition. The angular distribution of 74 pairs with energies between 6.5 and 8.75 Mev also favors M1 (or E2) as predominating among the lines in this energy region. The correlation of these results with other known data is discussed. (auth)

21237 CROSS-SECTION FLUCTUATIONS IN THE $Al^{27}(p,\alpha)Mg^{24}$ REACTION. B. W. Allardyce, W. R. Graham, and I. Hall (Oxford Univ.). Nucl. Phys., 52: 239-48(Mar. 1964).

Excitation functions in the differential cross sections at several angles and in the range 9 to 12 Mev were obtained for the $^{27}Al(p,\alpha)^{24}Mg$ reactions leading to the ground and first excited states of ^{24}Mg. The overall energy resolution was 10 kev. The cross sections exhibit marked fluctuations. There is little if any correlation between the cross sections for the two final states. Correlation functions are used to determine the fluctuation damping coefficient N and the mean level width of the intermediate nucleus Γ; the latter corresponding to a mean excitation of 22 Mev in ^{28}Si is found to be about 45 kev. The values of N thus obtained agree with those deduced otherwise from application of the cross section probability distribution formula. The experimental angular cross-correlations are studied in the light of recent theoretical estimates. (auth)

21238 THE 26.8 kev STATE OF I^{129}. N. Kaplan, S. Ofer, and H. Zmora (Hebrew Univ., Jerusalem). Nucl. Phys., 52: 249-52(Mar. 1964).

The half life of the 26.8-kev level of ^{129}I was measured and found to be 14.4 ± 0.5 nsec. The angular correlation of the 450 kev-26.8 kev cascade of ^{129}I was found to be isotropic to within 2%. (auth)

21239 PAIRING MODELS OF Pb^{206}, Pb^{204} AND Pb^{202}. R. W. Richardson and N. Sherman (Univ. of Michigan, Ann Arbor). Nucl. Phys., 52: 253-68(Mar. 1964).

Exact eigenstates of the pairing-force Hamiltonian are used to study pairing models of ^{206}Pb, ^{204}Pb, and ^{202}Pb. The properties of the eigenstates are discussed as functions of the interaction strength g and numerical results are given for $g = 0.146$ Mev. This interaction strength is stronger than the value, $g = 0.111$ Mev, adopted in a previous study of these models, which used the approximate methods of the theory of superconductivity. However, using the exact eigenstates and the stronger pairing interaction, the experimentally observed spectra of these three nuclei are predicted with an average error of 0.1 Mev. This error is 1/3 as large as that of the approximate calculation in which the weaker pairing interaction was used. (auth)

21240 GAMMA-GAMMA ANGULAR CORRELATION IN THE $Ni^{60}(n,\gamma)Ni^{61}$ REACTION. Z. Zámori (Central Research Inst. for Physics, Budapest). Nucl. Phys., 52: 269-72(Mar. 1964).

The gamma-gamma angular correlation of the 7.54-0.284 Mev cascade in the $^{60}Ni(n,\gamma)^{61}Ni$ reaction on enriched ^{60}Ni was measured. The result is discussed with a view to the possible spin assignment to the 284-kev level in ^{61}Ni. (auth)

21241 THE REACTION $F^{19}(d,n)Ne^{20}$. R. H. Siemssen (Institut für Experimentalphysik, Hamburg), R. Felst, M. Cosack, and J. L. Weil. Nucl. Phys., 52: 273-85(Mar. 1964).

Using a fast neutron time-of-flight spectrometer, the angular distributions of seven neutron groups leading to the ground state and the levels of ^{20}Ne at 1.63, 4.25, 4.97, 5.63, 5.80, and 6.75 Mev were measured at mean deuteron energies of 2.51, 2.61, 3.04, and 3.31 Mev. Only the neutron group to the 6.75-Mev level shows a clear stripping pattern at all energies, and it can be fitted with $l = 0$. The other angular distributions vary rapidly with energy and cannot be explained by plane wave stripping. The dimensionless stripping reduced width of the 6.75-Mev level at a bombarding energy of 3.31 Mev is $\theta^2 = 0.012$. It is compared to the theoretical predictions of the unified model, along with the results of other experimenters. (auth)

21242 THE EFFECTS OF MULTIPLE SCATTERING IN SMALL-ANGLE NUCLEAR SCATTERING EXPERI-

MENTS. A. M. Cormack (Tufts Univ., Medford, Mass.). Nucl. Phys., 52: 286-300(Mar. 1964).

The Molière theory of multiple scattering by a screened coulomb field is applied to typical data from various laboratories on p-nucleus scattering at small angles, and it is shown that in many cases the systematic errors due to multiple scattering are much larger than the published errors at the smallest scattering angles. A brief account of the Molière theory is given, with an extension to take into account the effects of beam size, beam divergence, and counter size, provided that, together, these can be represented by a Gaussian. The Molière theory is extended to take into account deviations from the screened coulomb field cross section caused by nuclear effects, provided that these deviations can be expressed as an additive correction to the screened coulomb field cross section. A method is outlined for extracting single scattering cross sections from data containing contributions from multiple scattering, the method being based on the validity of the Molière theory as a first approximation. (auth)

21243 NUCLEAR LEVELS OF ^{199}Au. M. C. Joshi, B. V. Thosar, and K. G. Prasad (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 52: 301-14(Mar. 1964).

The low energy level scheme of ^{199}Au as observed in the decay of 30 min. activity of ^{199}Pt was studied using an intermediate-image beta spectrometer and scintillation coincidence spectrometers in conjunction with a 512-channel analyzer. Four beta groups with end-point energies at 1690 ± 50, 1370, 1150, and 900 kev were identified. The gamma rays of energies 75, 197, 245, 320, 475, 540, 715, 790, and 960 kev were observed in the scintillation spectrum. To explain the various β-γ, γ-β, and γ-γ coincidences and their relative intensities, levels at 75, 320, 475, 540, 737, 790, and 960 kev are proposed. This new level scheme of ^{199}Au shows a close similarity with those of neighboring odd-mass gold nuclei. An isomeric state at about 475 kev was identified, also suggesting a possible existence of the $h_{11/2}$ state in the ^{199}Au nucleus. (auth)

21244 THE g-FACTOR OF THE 155 kev 2^+ LEVEL OF Os^{188}. H. Spehl, Th. Schmidt, H. Rieseberg, and G. Busch (Universität, Frieburg i. B.). Nucl. Phys., 52: 315-23(Mar. 1964). (In German)

The gyromagnetic ratio of the first excited 2^+ state of ^{188}Os was measured using a metallic target. The state was coulomb excited with a neutral hydrogen beam of 2.6 Mev. The precession of the γ-ray angular distribution was measured in an external magnetic field of 41,070 G. The gyromagnetic ratio was found to be g = 0.23 ± 0.03, in agreement with a recent measurement of Goldring, Kedem, and Vager. (auth)

21245 MEASUREMENT OF THE RATIO OF ELECTRON CAPTURE TO POSITON EMISSION IN THE DECAY OF Na-22. A. Williams (National Physical Lab., Teddington, Middx, Eng.). Nucl. Phys., 52: 324-32(Mar. 1964).

Using the 4π β-γ coincidence method, the ratio e/β^+ of electron capture to positon emission in the decay of ^{22}Na was measured as 0.1041 with a statistical error of ±0.45% and an estimated systematic error of ±0.5%. If it is assumed that the difference between this value and the theoretical value of 0.1135 ± 0.002 is due to Fierz interference, a value of $-(2.5 \pm 0.6)\%$ is obtained for the Fierz interference parameter, showing that more than one interaction is involved in allowed Gamow-Teller transitions. (auth)

21246 ANGULAR CORRELATION MEASUREMENTS IN Ne^{22}. D. Pelte, B. Povh, and W. Scholz (Universität, Freiburg i. B.). Nucl. Phys., 52: 333-41(Mar. 1964).

The first three excited states in ^{22}Ne were studied using the ^{19}F(^{4}He,pγ)^{22}Ne reaction at ^{4}He energies between 4.70 and 5.50 Mev. Angular correlations between protons and gamma rays were measured with the proton counter at 180°. The spin assignments for the 1.28-, 3.35-, and 4.47-Mev states were found to be 2, 4, and 2, respectively. A weak branch of about 4% from the 4.47-Mev state to the ground state suggests a positive parity assignment for the 4.47-Mev state. The predominant transition from this state, leading to the 1.28-Mev first excited state, has a quadrupole to dipole amplitude ratio $\delta = -0.06 \pm 0.04$. (auth)

21247 NUCLEON CLUSTERS IN LIGHT NUCLEI. R. I. Jibuti, T. I. Kopaleishvili, and V. I. Mamasakhlisov (Tbilisi State Univ., USSR). Nucl. Phys., 52: 345-52(Mar. 1964).

The (γ,pt) reaction is considered in terms of the nucleon cluster model. Expressions for the distribution over the relative energies of outgoing particles and the total cross section of the reaction are obtained. The results are compared with experimental data. A possible mechanism of the transition between cluster configurations in light nuclei is considered. (auth)

21248 A METHOD FOR ANALYSING GAMMA SPECTRA USING A COMPUTER. R. Freeman and G. S. Mani (Centre d'Etudes Nucléaires, Saclay, France). Nucl. Instr. Methods, 26: 34-6(Feb. 1964).

A simple method of analysis of gamma ray spectra using an IBM 7090 computer is described. (auth)

21249 ANALYSIS OF A CORRELATION FUNCTION AND MEASUREMENT OF HALF LIVES OF UNSTABLE STATES OF RADIOELEMENTS IN THE MILLISECOND RANGE. G. Landaud (Faculté des Sciences, Caen, France). Nucl. Instr. Methods, 26: 117-22(Feb. 1964). (In French)

A method based upon correlation techniques is proposed for measures of half lives of metastable states in the 10^{-6} to 10^{-2} sec range. (auth)

21250 THE DETERMINATION OF ANGULAR DISTRIBUTIONS IN ONE EXPERIMENT WITH TWO SOLID STATE DETECTORS. L. A. C. Koerts (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Instr. Methods, 26: 123-4 (Feb. 1964).

This note points out that it is feasible to replace the angle setting in a differential cross section determination by an energy measurement for those processes where a substantial recoil occurs. The angular distribution of some processes producing two charged particles can therefore be determined in one experiment with two solid state detectors operated in coincidence. The range of applicability of the method is discussed. (auth)

21251 A TECHNIQUE FOR REMOVING FICTITIOUS CASCADES IN SUM COINCIDENCE SPECTRA. S. O. Schriber and B. G. Hogg (Univ. of Manitoba, Can.). Nucl. Instr. Methods, 26: 141-6(Feb. 1964).

The simple cascades following the decay of ^{22}Na and ^{88}Y were used to illustrate a method of removing fictitious cascades appearing in sum coincidence spectra. (auth)

21252 PROTON SPIN FLIP AND SUBSTATE EXCITATION IN INELASTIC SCATTERING. F. H. Schmidt, Ronald E. Brown, J. B. Gerhart, and Wojciech A. Kolasinski (Univ. of Washington, Seattle). Nucl. Phys., 52: 353-80(Mar. 1964).

The angular correlation between inelastically scattered protons and gamma rays in $0^+ \rightarrow 2^+ \rightarrow 0^+$ processes is interpreted in terms of the substate populations of the excited states. A correlation perpendicular to the reaction plane gives the $m = \pm 1$ populations, and it is shown that these are equal to the fraction of protons undergoing

spin flip along this direction (z-axis). A combination of z-axis and reaction-plane correlation measurements gives the other substate populations. The general applicability of the method is discussed in detail. Both types of correlation measurements were made for ^{12}*C (4.43 Mev) at 10.3 Mev for 5 proton angles, and the z-axis correlation was measured over a range of energies near 10.3 Mev for proton angles from 20 to 165°. The z-axis correlation only was measured for the reactions ^{24}*Mg (1.37 Mev) and ^{58}*Ni (1.45 Mev). The results for ^{12}C and ^{24}Mg show that spin flip varies rapidly with scattering angle and with energy, and that it occurs in amounts varying from ≈ 0 to ≈ 40%. Resonance effects are probably dominant in both cases. For ^{58}Ni spin flip occurs with a substantial probability but does not vary rapidly with angle. The relative substate populations for ^{12}C excitation vary widely with scattering angle. The symmetry angles for the m = ±1 and m = ±2 substates are different from one another and also change with scattering angle. (auth)

21253 THE ENHANCEMENT OF SINGLE-PARTICLE TRANSITION RATES IN C^{13}. M. A. Nagarajan (Univ. of California, Berkeley). Nucl. Phys., 52: 381-4(Mar. 1964). (UCRL-10982)

It was recently shown that the collective enhancement of the quadrupole transition in ^{12}C can be explained by introducing correlations in the ground state of ^{12}C. The effect of these ground state correlations on the single particle transition rates in ^{13}C is studied. (auth)

21254 ANGULAR CORRELATIONS FOR $C^{12}(p,p'\gamma)C^{12}$ IN A RESONANCE-FREE REGION. A. M. Baxter (Univ. of Melbourne), K. G. McIntyre, G. G. Shute, and D. Robson. Nucl. Phys., 52: 385-409(Mar. 1964).

The reaction $^{12}C(p,p'\gamma)^{12}C$ involving the first excited state at 4.43 Mev was investigated experimentally by measurements of the $p'-\gamma$ correlation and the proton angular distribution for an incident energy of 8.5 Mev. Although this energy corresponds to a region having no sharp resonances, the experimental results show that none of the simple models of the reaction mechanism are valid, because of the important contributions from proton spin-flip during the inelastic scattering. The simplified distorted-wave theory of direct interactions is improved by including the effects of spin-orbit distortion, and an attempt is made to explain all the available data at 8.5 Mev. Partial success is achieved, and it appears that the inelastic scattering in this energy region is dominated by a direct interaction mechanism. The inclusion of spin-orbit distortion is found to be important. In contrast to previous work the correlation function is found to be relatively insensitive to the detailed nature of the target-nucleus wave functions. (auth)

21255 INVESTIGATION OF THE ENERGY LEVELS OF F^{21} USING THE $F^{19}(t,p)F^{21}$ REACTION. P. Horvat (Univ. of Manchester, Eng.). Nucl. Phys., 52: 410-16 (Mar. 1964).

The energy levels of ^{21}F up to an excitation energy of 5.9 Mev were investigated. Previously unreported levels were found at 5.35, 5.49, (5.57), 5.59, 5.79, and 5.88 Mev. The energy levels below 5.07 Mev are found to be in agreement with previous work. The proton groups with angular distribution characteristic of direct interactions were interpreted as stripping of two neutrons. Thus $^1/_2^+$ for the spin and parity of the 0.28 Mev first excited state was obtained. The spins and parities of the ground state and of the 3.45, 3.51, 4.57, 5.07, and 5.59 Mev excited states are $^5/_2^+$ or $^3/_2^+$, whereas the spin and parity of the 3.63 Mev excited state are tentatively $^7/_2^-$ or $^5/_2^-$. A semiqualitative interpretation of the positive parity states in terms of the unified model is attempted. (auth)

21256 THE LOW-LYING LEVELS OF Al^{27}. [PART] I. T. R. Ophel and B. T. Lawergren (Australian National Univ., Canberra). Nucl. Phys., 52: 417-36(Mar. 1964).

Various techniques of γ-ray spectroscopy were employed to examine γ-ray transitions between the low-lying levels of ^{27}Al. Branching ratios of the 2.21, 2.73, and 2.98 Mev levels were measured and the (E2/M1) mixing ratios determined for the 2.73 → 1.01 and 2.73 → 0 transitions. (auth)

21257 ENERGY SPECTRA OF PHOTONEUTRONS FROM THE REACTIONS $O^{16}(\gamma,n)$, $S^{32}(\gamma,n)$ AND $Ca^{40}(\gamma,n)$. F. W. K. Firk (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Phys., 52: 437-48(Mar. 1964).

The energy spectra of photoneutrons from the reactions $^{16}O(\gamma,n)$, $^{32}S(\gamma,n)$, and $^{40}Ca(\gamma,n)$ were measured using the Harwell 33 Mev electron linear accelerator and associated nanosecond neutron time-of-flight spectrometer. The energy resolution is 4 kev for a 1 Mev neutron increasing to 100 kev at 9 Mev. Detailed fine structure is observed throughout the giant dipole resonance regions of the nuclei studied. Measurements are made at several different values of the bremsstrahlung end point in an attempt to establish ground state neutron transitions. Good agreement is found between the present results and recent (p,γ_0) data for the energies and relative widths of levels in ^{16}O, ^{32}S, and ^{40}Ca. Shell-model calculations, including single particle-hole interactions, which predict the energies and strengths of 1^- states in ^{16}O do not account for the structure observed in these measurements. A recent suggestion by Boeker, that a 1^- particle-hole excitation may occur coupled with a 0^+ or 2^+ surface vibration, predicts a splitting of each major particle-hole state; this prediction is more in accord with the observed ^{16}O data. (auth)

21258 ALPHA ACTIVE ISOMERS IN Bi^{201} AND Bi^{199}. A. Siivola (Univ. of Helsinki), P. Kauranen, B. Jung, and J. Svedberg. Nucl. Phys., 52: 449-56(Mar. 1964).

Isomerism was established in ^{201}Bi and indicated in ^{199}Bi from sources prepared with refined chemical procedures and electromagnetic mass separation. Measurements with a gridded ionization chamber resulted in the following alpha-particle energies and half lives: ^{201m}Bi 5.27 ± 0.02 Mev, 52 ± 2 min and ^{199m}Bi 5.52 ± 0.02 Mev, 24.4 ± 0.5 min. The element assignment of the 7 min 5.83 Mev alpha activity, earlier assigned to ^{198}Bi, was confirmed and more accurate values of the energy and half life obtained (5.81 ± 0.03 Mev, 8.0 ± 0.5 min). The electron capture half life of ^{199}Bi was measured to be 27 ± 1 min. (auth)

21259 A STUDY OF THE (He^3,n) REACTION ON C^{12} AND C^{13}. V. K. Deshpande, H. W. Fulbright, and J. W. Verba (Univ. of Rochester, N. Y.). Nucl. Phys., 52: 457-64(Mar. 1964). (TID-19684)

Angular distributions and excitation curves are presented for the $^{12}C(^3He,n)^{14}O$ (ground state) reaction for bombarding energies between 5.5 and 11 Mev and for the $^{13}C(^3He,n)^{15}O$ (ground state) reaction for bombarding energies between 7.5 and 11 Mev. The angular distributions in both cases have peaks at 0°. They are analyzed in terms of Newns' double stripping theory. In the case of ^{12}C, the 0° cross section shows a large variation with energy, while in the case of ^{13}C the excitation curve is relatively flat. Results are compared with the available data from corresponding $(^3He,p)$ reactions. (auth)

21260 SCATTERING OF 65-Mev HELIUM IONS FROM O^{16}. B. G. Harvey, E. J-M. Rivet, A. Springer, J. R. Meri-

wether, W. B. Jones, J. H. Elliott, and P. Darriulat (Univ. of California, Berkeley). Nucl. Phys., 52: 465-80(Mar. 1964). (UCRL-10727(Rev.))

In the inelastic scattering of 65 Mev helium ions by ^{16}O, the following levels of ^{16}O were excited: 6.134, 6.918, 7.118, 8.876, 9.850, 10.363, 11.083, 11.52, 12.02, 12.443 + 12.528 (unresolved), 12.968 + 13.101 (unresolved), 13.981, and 14.94 Mev. Angular distributions were obtained for the particle groups corresponding to nearly all these ^{16}O levels. The levels at 8.876, 11.083, 12.528, 12.968, and 13.981 are of unnatural parity (i.e., parity $(-)^{J+1}$). At small angles the angular distributions of the 8.876 Mev 2^- level oscillate in phase with the elastic angular distribution as a negative parity level should, but at angles greater than 45°, it behaves more like a positive parity level. The T = 1 levels at 12.968 and 13.101 Mev were excited about as strongly as neighboring T = 0 levels. All negative parity levels of the p^{-1} (s,d) configuration were observed where not forbidden by selection rules or obscured by their great width. The 9.59 Mev 1^- level was not observed; this absence confirms that it is a level of three-particle excitation. The 3^- level at 6.134 Mev showed collective enhancement of its cross section. (auth)

21261 THE 10.43-Mev STATE IN N^{14}. H. J. Rose, F. Riess, and W. Trost (Universität, Freiburg i. B.). Nucl. Phys., 52: 481-96(Mar. 1964).

The gamma decay scheme of the 10.43 Mev state in ^{14}N was investigated by means of the reaction $^{13}C(p,\gamma)^{14}N$. Apart from the known gamma transitions to the ground state and the 6.44 Mev excited state, a previously unreported gamma transition was found to the J = 2 excited state at 7.03 Mev with an intensity of 8% of that of the ground state transition. A transition to the 7.03 Mev state was also established in the decay scheme of the $J^\pi = 2^+$, 9.17 Mev state by previous work. Furthermore, several weak gamma rays were observed originating from the decay of the 10.43 Mev state. These rays arise from the populations and decays of the lowest odd parity states in ^{14}N at 5.10, 5.69, and 5.83 Mev and possibly the $J^\pi = 1^+$ state at 3.95 Mev. However, because of their weakness, only the decay mode to the 5.10 Mev state is definitely established. The work presents rather strong evidence that the 9.17 Mev and the 10.43 Mev states have similar eigenfunctions and that these eigenfunctions contain approximately equal contributions from p^{-2} and (2s, 1d), with a small contamination from p^3f. (auth)

21262 DECAY OF 5.4-d Pm^{148}. Joseph W. Harpster and Karl J. Casper (Western Reserve Univ., Cleveland). Nucl. Phys., 52: 497-504(Mar. 1964).

The spin and parity of the 1.46 Mev excited state of ^{148}Sm populated by the decay of 5.4 d ^{148}Pm were investigated using angular correlation techniques. Both directional correlation and polarization direction correlation measurements were made on the 910–550 kev cascade. On the basis of these measurements, it was possible to make an assignment of 1^- for the spin and parity of the 1.46 Mev level. (auth)

21263 ANGULAR AND ENERGY DISTRIBUTIONS OF NEUTRONS FROM THE INTERACTION OF 14-Mev NEUTRONS WITH Li^6 AND Li^7. Alice H. Armstrong (Los Alamos Scientific Lab., N. Mex.), Juanita Gammel, Louis Rosen, and Glenn M. Frye, Jr. Nucl. Phys., 52: 505-14 (Mar. 1964). (LADC-5645)

The angular and energy distributions from the interaction of 14 Mev neutrons with ^6Li and ^7Li were determined from analysis of nuclear plate detectors placed at 10° intervals from 10° to 160°. The angular distributions of the elastically scattered neutrons are similar not only to those expected on the basis of diffraction scattering, but also to those obtained from an optical model analysis with parameters identical to those used for fitting medium-weight and heavy nuclei. The total elastic scattering cross section for ^6Li is 883 ± 95 mb; for ^7Li, 969 ± 110 mb. The neutrons from inelastic collisions are much less peaked in the forward direction and exhibit a considerable isotropic component. The measured value for the total cross section for the emission of neutrons for ^6Li is 1.44 ± 0.16 b; for ^7Li, 1.61 ± 0.2 b. (auth)

21264 ENERGY LEVELS OF ^{36}Ar AND ^{38}Ar FROM ALPHA CAPTURE IN SULPHUR AND PROTON CAPTURE IN CHLORINE. F. C. Erné and C. Van Der Leun (Rijksuniversiteit, Utrecht). Nucl. Phys., 52: 515-23(Mar. 1964).

The reactions $^{32}S(\alpha,\gamma)^{36}Ar$ and $^{34}S(\alpha,\gamma)^{38}Ar$ were investigated in the energy range E_α = 2.2–3.2 Mev. Five resonance states in $^{36}Ar(E_x$ = 8.9–9.5 Mev) and six in $^{38}Ar(E_x$ = 9.6–10.1 Mev) were found. The excitation energies and resonance strengths are reported. The spins and parities of most resonances showing a ground-state transition were determined from angular distribution measurements. The relative strengths of the $J^\pi = 1^-$ resonances in ^{36}Ar and ^{38}Ar indicate that the isobaric-spin selection rule for electric dipole transitions in self-conjugate nuclei is still effective in this mass region. The slowing-down factor for these transitions amounts to about ten. The $^{35}Cl(p,\gamma)^{36}Ar$ reaction for E_p = 0.4–1.0 Mev leads to twenty ^{36}Ar levels in the excitation range covered in the $^{32}S(\alpha,\gamma)^{36}Ar$ experiment. The yield curves of the two reactions are compared. Three ^{36}Ar resonance levels are excited in both the (p,γ) and the (α,γ) reaction. (auth)

21265 SPIN-PARITY OF 53-MIN Cs^{135m}. I. B. Haeller and B. Jung (Uppsala Univ.). Nucl. Phys., 52: 524-8(Mar. 1964).

Measurements of the relative conversion-electron intensities in the decay of $^{135\,m}Cs$ performed in a double focussing β spectrometer suggest that the spin-parity of the isomeric state is $^{19}/_2^-$. The mass assignment of the 53 min. activity was checked by γ spectroscopy on electromagnetically mass-separated sources. (auth)

21266 ON THE NUCLEAR DIRECT PHOTODISINTEGRATION. G. Ponzano (Università, Turin). Nuovo Cimento (10), 31: 1303-23(Mar. 16, 1964).

The individual-particle shell model is used in order to describe the initial and final nuclear states that are involved in the nuclear direct photodisintegration. General formulas for the final statistical matrix are deduced in the case of initially polarized nuclei and polarized photons. These results are expressed in the extreme j-j as well as in the extreme L-S coupling scheme. Some reasonable limiting assumptions are made with the aim of pointing out how the angular correlations depend on the coupling scheme. The first p-shell is considered in detail; it is found that the cross section depends remarkably on the coupling scheme, and that the polarization can change its sign in addition to its value. (auth)

21267 ON THE DECAY OF ^{113}Sn. C. Manduchi, G. Nardelli, M. T. Russo-Manduchi, and G. Zannoni (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Nuovo Cimento (10), 31: 1380-3(Mar. 16, 1964).

The measurement of the L/K-capture ratio in the electron-capture decay of ^{113}Sn is reported using gaseous tetramethyl-tin as radioactive source in the counter gas of a multiwire proportional counter. 18 references. (R.E.U.)

21268 PRESSURE WAVE GENERATED IN A FISSIONABLE GAS BY NEUTRON IRRADIATION. H. P. Smith, Jr., C. W. Busch, and A. K. Oppenheim (Univ. of California, Berkeley). Phys. Fluids, 7: 676-83(May 1964).

An experiment is proposed to study the nonsteady gasdynamic phenomena produced by neutron induced exothermic nuclear reactions in a gaseous medium. The problem is formulated in terms of a set of characteristic equations in a time dependent, spatially unidimensional system and solved by means of a simplified analysis leading to a system of two first order, nonlinear, ordinary differential equations that permit the attainment of a clearer understanding of the salient features of the problem than can be obtained from a more rigorous solution. The problem involves the generation of a pressure wave in a long tube filled with a boron trifluoride, fully enriched in the boron-10 isotope which undergoes the reaction: $^{10}B(n,\alpha)^{7}Li$ as a result of a 1000 Mw neutron pulse of approximately 10 msec halfwidth directed along part of its length by irradiation from a reactor. The analysis predicts that the gas residing initially in the core will be heated to approximately 3000°K and that a compression wave with a peak pressure ratio of approximately 3 will emanate from the reactor and coalesce into a shock of Mach number 1.8 at a distance of approximately 17 ft from the reactor core. Measurement of the pressure wave should provide information on the amount of reversible heating that can be obtained from a gaseous nuclear reaction. It should be considered therefore of particular value in gaining specific familiarity with fissionable gasdynamics. (auth)

21269 CIRCULAR POLARIZATION MEASUREMENT OF GAMMA RAYS FOLLOWING BETA DECAY OF Al^{24} AND Na^{24} TO DETERMINE THE MESON EXCHANGE EFFECT. S. D. Bloom (Univ. of California, Livermore), L. G. Mann, R. Polichar, J. R. Richardson, and A. Scott. Phys. Rev., 134: B481-4(May 11, 1964). (UCRL-7230; UCRL-7230(Rev.I))

The β-circularly polarized γ angular correlations for ^{24}Al and ^{24}Na were measured and compared to determine the size of the Fermi matrix elements M_π due to meson exchange and $a_0(1)\sqrt{2}$ due to isospin impurities. The polarimeter was a cylindrical magnet that produces 19000 G in the form of a square wave oscillating at 140 cps. At this frequency the 2.1-sec half life presents no new problem except one of source handling. A pneumatic tube was used to transport sources between the polarimeter and the UCLA cyclotron internal beam. The results (using superscripts + and − to denote ^{24}Al and ^{24}Na, respectively) are A^+ (the circular polarization asymmetry parameter) = −0.084 ± 0.054, $A^- = 0.091 \pm 0.017$, $M_F^+ = (0.06 \pm 5.4) \times 10^{-3}$, and $M_F^- = (0.8 \pm 1.7) \times 10^{-3}$. From $M_\pi = \frac{1}{2}(M_F^- - M_F^+)$ and $a_0(1)\sqrt{2} = \frac{1}{2}(M_F^- + M_F^+)$, $M_\pi = (0.4 \pm 3) \times 10^{-3}$ and $a_0(1)\sqrt{2} = (0.4 \pm 3) \times 10^{-3}$ in this isobaric triplet. With the CVC conserved vector-current hypothesis M_π should be zero. (auth)

21270 DECAY OF 92.5-MIN La^{142}. W. V. Prestwich and T. J. Kennett (McMaster Univ., Hamilton, Ont.). Phys. Rev., 134: B485-99(May 11, 1964).

The decay properties of 92.5-min. ^{142}La were studied using scintillation spectrometric techniques. The energies, intensities, and time-correlations of the associated beta and gamma transitions were investigated. The gamma-ray energies (and relative intensities) observed are: 0.645 (1.000), 0.86 (0.05), 0.898 (0.185), 1.01 (0.094), 1.06 (0.077), 1.16 (0.059), 1.25 (0.057), 1.37 (0.050), 1.55 (0.053, 0.044), 1.74 (0.106), 1.91 (0.176), 2.06 (0.132), 2.14 (0.044), 2.19 (0.099), 2.41 (0.314), 2.55 (0.227), 2.67 (0.061), 2.80 (0.046), 2.99 (0.11), 3.14 (0.021), 3.31 (0.039), 3.45 (0.026), and 3.65 (0.048) Mev. The beta-ray groups (and approximate branching ratios) are 4.49 (13%), 3.85 (2%), 2.98 (2%), 2.31 (7%), 2.11 (24%), 1.98 (20%), 1.79 (11%), 1.23 (5%), and 0.87 (13%) Mev. On the basis of these results, a decay scheme was constructed with excited states in ^{142}Ce at 0.645, 1.54, 1.66, 2.02, 2.19, 2.41, 2.55, 2.71, 3.31, 3.45, and 3.65 Mev. The Q_β value for the $^{142}La-^{142}Ce$ decay was found to be 4.51 ± 0.03 Mev. (auth)

21271 PROPERTIES OF GAMMA TRANSITIONS IN THE DECAYS OF Sm^{153} AND Gd^{153} INTO Eu^{153}. Peter Alexander (California Inst. of Tech., Pasadena). Phys. Rev., 134: B499-502(May 11, 1964).

The energies and relative intensities of gamma rays produced in the electron-capture decay $^{153}Gd \rightarrow {}^{153}Eu$ and of the low-energy gamma rays produced in the beta decay $^{153}Sm \rightarrow {}^{153}Eu$ were studied with the bent-crystal spectrometer. Two previously unreported gamma rays were observed at 54.19 and 68.23 kev. These together with a previously reported 151.5-kev gamma transition depopulate a new state at 151.61 kev that is proposed as the $\frac{7}{2}^-$, $K = \frac{5}{2}$ level of ^{153}Eu. The M1 gamma-ray interband branching ratio from the known 173-kev $\frac{5}{2}^+$, $K = \frac{3}{2}$ level and the E1 gamma branching ratio from the 151.61-kev level are examined for evidence of band mixing. (auth)

21272 NUCLEAR HYPERFINE STRUCTURE IN Er^{166}. R. L. Cohen and J. H. Wernick (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 134: B503-5(May 11, 1964).

The Mössbauer effect was used to study hyperfine structure in the 81-kev ($2^+ \rightarrow 0^+$) transition in ^{166}Er, using $HoAl_2$ as a source. Absorbers of Fe_2Er, Er metal, $ErFe_3Mn$, and Er_2O_3 were studied with the following results: Magnetic moment of the excited state, 0.61 nm; quadrupole moment, approximately −1.6 b; magnetic moment of the Er^{3+} ion in erbium metal at 21°K, 7.5 ± 0.6 μ_B. The nuclear moments are in good agreement with the values predicted from the collective model, and with other experimental determinations. The resonance absorption is much less than 1%, but the relatively large hyperfine interaction and high counting rates possible make the measurements fairly easy. (auth)

21273 PRECISION DETERMINATION OF THE ENERGY OF THE GAMMA RAY OF POTASSIUM-40. Berol L. Robinson (Western Reserve Univ., Cleveland and Israel Atomic Energy Commission, Rehovoth). Phys. Rev., 134: B506-9(May 11, 1964).

The gamma ray of potassium-40 was compared with the 1368-kev line of sodium-24 in a scintillation spectrometer. The lines of yttrium-88 were simultaneously recorded, and linear interpolation between these lines was corrected to bring the sodium-24 value into accord with the accepted standard value. A proportional correction was applied to the interpolated value for the energy of the potassium-40 line. Sources consisted of (i) yttrium-88 mixed with potassium bicarbonate, and (ii) yttrium-88 mixed with sodium bicarbonate, with the sodium activated by a small neutron source. About seven kilograms of bicarbonate were used in each case; to obtain sufficient potassium-40 activity in (i), and to simulate approximately the small-angle Compton scattering in a substance of equal density in (ii). Full-energy peaks in the pulse-height spectra were fitted to a normal distribution by an iterative method of least squares. With about 100,000 counts in each peak, energy determinations were reproducible to about 0.5 kev. The energy of the potassium gamma ray is 1459.7 ± 1.0 kev. The dependence of the result upon changes in the standards is also given. (auth)

21274 MEASUREMENT OF THE PLANE POLARIZATION OF GAMMA RADIATION. James N. Haag (Univ. of California, Berkeley). Phys. Rev., 134: B509-14(May 11, 1964). (UCRL-10880)

A simplified experimental technique, utilizing Compton scattering as the analyzing process, was developed for the measurement of the plane polarization of gamma radiation emitted from oriented nuclei. Nuclei of ^{139}Ce and ^{141}Ce were aligned in a neodymium ethylsulfate lattice at low temperatures by the magnetic-hyperfine-structure method. The plane polarization of the emitted gamma radiation was measured as a function of temperature. The measured polarization of this radiation was found to be consistent with published results. (auth)

21275 SPECTROSCOPY IN THE NUCLEAR $1f_{\frac{7}{2}}$ SHELL. J. D. McCullen, B. F. Bayman, and Larry Zamick (Princeton Univ., N. J.). Phys. Rev., 134: B515-38(May 11, 1964). (PUC-1963-118)

The properties of nuclei with $20 \leq Z, N \leq 28$ that are consistent with wave functions composed of a ^{40}Ca core plus Z-20 protons and N-20 neutrons in the $1f_{\frac{7}{2}}$ shell are determined. The $1f_{\frac{7}{2}}$ nucleon-nucleon interaction was determined from the observed levels of ^{42}Sc, assuming that these can be interpreted as due to the configuration $(1f_{\frac{7}{2}})^2$. The interaction is treated exactly, within the framework of a pure configuration assumption. Many of the observed properties of these nuclei were found to be reproduced by this model, in particular the systematics of low-lying nuclear spins, magnetic moments, ft values, and (p,d) and (d,p) spectroscopic factors. However, several nuclei have more low-lying states than the $(1f_{\frac{7}{2}})^n$ configuration can provide at the corresponding energies. (auth)

21276 QUADRUPOLE MOMENT OF THE SECOND EXCITED STATE OF F^{19}. Kenzo Sugimoto, Akira Mizobuchi, and Kozi Nakai (Osaka Univ.). Phys. Rev., 134: B539-42 (May 11, 1964).

The differential anisotropy of the delayed angular distribution of the 198-kev gamma radiation following the inelastic scattering of protons by ^{19}F was investigated using various chemical forms of target materials. While in the case of a KF target, no appreciable time variation of anisotropy was observed within the time interval measured, in the cases of a ClF target and a $(C_2F_4)_n$ target the characteristic patterns for the static quadrupole coupling of the polycrystalline state were observed. It was found to be necessary to interpret the patterns on the basis of a frequency distribution in the range of about ten percent. The mean values for the fundamental frequency of quadrupole coupling were found to be 12.4 ± 0.6 Mc for ClF and 9.0 ± 0.4 Mc for $(C_2F_4)_n$. The strength of the electric field gradient q of the nuclear environment in ClF was estimated as $q = 1.07 \times 10^{16}$ esu, following the empirical rule of Townes and Dailey. The nuclear quadrupole moment Q was deduced to be $|Q(^{19}F, \frac{5}{2}^+)| = 0.11$ b. The uncertainty due to various causes of the moment Q obtained was estimated to be about 20%. (auth)

21277 NILSSON MODEL CALCULATIONS OF Mu CAPTURE RATES IN 2s–1d NUCLEI. Richard R. Silbar (Univ. of Michigan, Ann Arbor). Phys. Rev., 134: B542-56 (May 11, 1964).

Theoretical calculations of mu capture rates in 2s–1d nuclei are compared with experiment in the hope of elucidating the coupling constants of the interaction. Working from Primakoff's closure-approximation expression for the total average capture rate, the nuclear matrix element is treated in the context of the Nilsson unified model. A Hill-Wheeler integration must be performed to avoid extraneous coordinates in the A-particle wave function. The one- and two-particle parts of the matrix element are broken up into the various shell contributions, since all of the angular momentum properties reside in the shell wave function for the nucleons outside the ^{16}O core. The closed-shell matrix elements are easily treated with standard angular-momentum techniques. The method for reducing the outer-shell matrix elements to a form amenable to evaluation by a computer is given. Radial integrals are obtained from the Ford-Wills muon wave functions. The average neutrino momentum ($\overline{\nu}$) is chosen on the basis of Kaplan's Fermi-gas model for the capture process and the subsequent comparison with neutron evaporation rates. The choice of nuclear parameters for ^{19}F, ^{20}Ne, ^{28}Si, ^{35}Cl, and ^{37}Cl is discussed and numerical results are given. Comparing with experimental rates, the possibility that the Fermi part of the interaction is absent is not excluded. If a V–A theory is assumed, however, it is concluded that the induced pseudoscalar coupling is probably present. The induced pseudoscalar with the "wrong" sign, $g_P = -8g_A$, is definitely excluded, and the "large" pseudoscalar, $g_P = 16g_A$, seems to fit the data better at $\overline{\nu} = 0.75$. (auth)

21278 NEUTRON PHOTOPRODUCTION CROSS SECTIONS OF LANTHANUM AND PRASEODYMIUM. L. B. Rice, L. N. Bolen, and W. D. Whitehead (Univ. of Virginia, Charlottesville). Phys. Rev., 134: B557-9(May 11, 1964).

The (γ,n) cross sections for La and Pr were determined from threshold to 30 Mev. The two cross sections are similar, and both deviate from a Lorentz line shape. The parameters for the two cross sections are La, $\sigma_m = 304$ mb, $E_m = 14.5$ Mev, $\sigma_{int} = 1.36$ Mevb, $\Gamma_{Lor} = 3.3$ Mev; Pr $\sigma_m = 305$ mb, $E_m = 14.8$ Mev, $\sigma_{int} = 1.47$ Mevb, $\Gamma_{Lor} = 3.3$ Mev. (auth)

21279 CROSS SECTIONS AND ISOMER RATIOS FOR THE ISOMERIC PAIR Y^{90g} AND Y^{90m} IN THE $Rb^{87}(\alpha,n)$ AND $Y^{89}(d,p)$ REACTIONS. Clyde Riley and Bruno Linder (Florida State Univ., Tallahassee). Phys. Rev., 134: B559-64(May 11, 1964).

Excitation functions and cross section ratios for the isomeric pair Y^{90g} and Y^{90m} produced from ^{87}Rb by (α,n) reaction and from ^{89}Y by (d,p) reaction were measured from 11 to 18 and 5 to 12 Mev, respectively. The isomer ratios produced in (d,p) reaction are approximately an order of magnitude smaller than those obtained by (α,n) reaction; the total cross sections for both reactions are comparable. The differences in the isomer ratio curves are accounted for by differences in mechanism. The experimental isomer ratios obtained in the (α,n) reaction are compared with the predicted values calculated in the manner of Huizenga and Vandenbosch. The results are discussed. (auth)

21280 INTERPRETATION OF THE FRAGMENT MASS DISTRIBUTION FOR U^{235} THERMAL-NEUTRON-INDUCED FISSION WITH LONG-RANGE ALPHA EMISSION. H. W. Schmitt (Oak Ridge National Lab., Tenn.) and N. Feather. Phys. Rev., 134: B565-7(May 11, 1964).

An analysis of the fragment mass distribution for the thermal-neutron-induced ternary fission of ^{235}U is given. Quantitative comparison of the mass-distribution data for binary and ternary fission is consistent with the influence of the closed-shell configurations in fission, although it is shown that these mass distributions of themselves are not sufficient to determine unambiguously the origin of the alpha particle. Results of this analysis are discussed in relation to some recently proposed models of ternary fission. It is shown that the results of measurements of the number of neutrons emitted in binary fission, as a function

of fragment mass, are consistent with the cluster-model interpretation. (auth)

21281 COULOMB EXCITATION OF Cu^{63} AND Cu^{65}. R. L. Robinson, F. K. McGowan, and P. H. Stelson (Oak Ridge National Lab., Tenn.). Phys. Rev., 134: B567-74 (May 11, 1964).

Properties of levels Coulomb excited in ^{63}Cu and ^{65}Cu with 4- to 8-Mev alpha particles were investigated. The B(E2)'s for excitation determined from the yields of gamma rays observed in singles and coincidence spectra for the (668 ± 4)-, (961 ± 6)-, and (1323 ± 16)-kev levels in ^{63}Cu are, respectively, (1.16 ± 0.12), (3.49 ± 0.34), and (4.0 ± 0.5) × 10^{-50} e^2 cm^4; for the (771 ± 7)-, (1115 ± 11)-, and (1474 ± 19)-kev levels in ^{65}Cu, they are (1.02 ± 0.11), (3.45 ± 0.38), and (4.3 ± 0.8) × 10^{-50} e^2 cm^4. These results give B(E2)'s for decay that are 13 to 16 times the single-particle B(E2). This similarity of B(E2)'s was predicted by de Shalit for levels that result from the coupling of the odd particle to the first excited state of the even-even core. From angular correlation studies the 961- and 1115-kev levels were assigned spin $\frac{5}{2}$ and the 1323-kev level spin $\frac{7}{2}$. Mixing ratios obtained from these measurements along with the B(E2)'s establish values of 0.09 and 0.4 $(e\hbar/2\ Mc)^2$ for the B(M1)'s of the 961- and 1115-kev transitions. (auth)

21282 DIFFERENTIAL CROSS SECTIONS FOR TRITON-INDUCED REACTIONS ON N^{14}. R. B. Schwartz, H. D. Holmgren, L. M. Cameron, and A. R. Knudson (Naval Research Lab., Washington, D. C.). Phys. Rev., 134: B577-86(May 11, 1964).

Differential cross sections were measured as functions of angle and bombarding energy in the region from 1 to 2 Mev for the following reactions: (1) $^{14}N(t,t)^{14}N$; (2) $^{14}N(t,\alpha)^{13}C$ going to the ground state and the 3.09-Mev state in ^{13}C; (3) $^{14}N(t,d)^{15}N$ going to the ground state of ^{15}N; and (4) $^{14}N(t,p)^{16}N$ going to the ground state and the 0.120-, 0.295-, and 0.392-Mev states of ^{16}N. The total cross sections for the last three of these reactions at 2 Mev are: (2) 11 and 6 mb; (3) 48 mb; and (4) 7, 4, 9, and 8 mb, respectively. The energy and angular behavior of the differential cross sections suggest that most of these reactions proceed predominantly by direct interactions. The large absolute value of the cross section for the $^{14}N(t,d_0)^{15}N$ reaction, as well as the energy and angular behavior of the differential cross section, suggest that this reaction may proceed by a cluster exchange process. Distorted-wave Born approximation calculations provide satisfactory fits to the (t,α_0) angular distribution, but not the (t,d_0). Plane-wave calculations including exchange stripping give more acceptable fits to the (t,d_0) data. (auth)

21283 DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $Li^7(Li^7,\alpha)Be^{10}$. T. G. Dzubay and J. M. Blair (Univ. of Minnesota, Minneapolis). Phys. Rev., 134: B586-90(May 11, 1964).

Absolute differential cross sections are presented for the reaction $^7Li(^7Li,\alpha)^{10}Be$, where the ^{10}Be is left in its ground state, first excited state, and combined second, third, and fourth excited states, for laboratory energies from 2.30 to 3.77 Mev. The total cross sections exhibit the rapid rise with increasing energy usually shown by heavy-ion reactions at low energies. The ratios of the coefficients of the Legendre polynomials, which describe the angular distributions, show structure in the neighborhood of 3.2-Mev bombarding energy. This is thought to be indicative of a compound-nucleus contribution. (auth)

21284 (p,n) THRESHOLD-CURVE SHAPES AND MEASUREMENTS OF THRESHOLD ENERGY WITH H_1^+ BEAMS. R. O. Bondelid and E. E. Dowling Whiting (Naval Research Lab., Washington, D. C.). Phys. Rev., 134: B-591-4 (May 11, 1964).

Yield curves were calculated for (p,n) threshold reactions, and the results were applied to data previously obtained with a two-meter electrostatic analyzer. Taken into account in the calculation are the finite beam-energy spread from the analyzer, Doppler broadening due to thermal motion of the target nuclei, and the effect due to the statistical nature of the energy loss of protons in the target. A comparison of the yield-curve shape when the cross section is proportional to the emitted neutron velocity and the yield-curve shape when there is a nearby resonance is made. There is a small but calculable difference between the extrapolated yield curve intercept and true threshold energy. The threshold energies for several reactions are determined from data previously reported: $T(p,n)^3He$, 1019.76 ± 0.51 kev; $^7Li(p,n)^7Be$, 1881.27 ± 0.94 kev; $^{13}C(p,n)^{13}N$, 3237.1 ± 1.6 kev. (auth)

21285 DECAY SCHEME OF THE ISOMERS OF Te^{129}. S. H. Devare and H. G. Devare (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 134: B705-17(May 25, 1964).

The decay of 70-min ^{129}Te and 33-day ^{129m}Te was studied using a beta-ray spectrometer, scintillation spectrometers, and coincidence techniques. The 70-min activity, studied in equilibrium with ^{129m}Te and also independently, was seen to emit gamma rays of energies 27, 205, 245, 275, 350, 455, 550, 625, 755, 810, 825, 960, 1080, and 1235 kev. From coincidence relations among these gamma rays, it was concluded that levels at 27, 275, 350 or 755, 482, 550, 810, 1105, and 1235 kev are excited in the decay of the 70-min activity. ^{129m}Te was observed to decay by the emission of gamma rays of energies 550, 695, 720, and 830 kev in addition to the 106-kev isomeric transition. These gamma rays were attributed to the excitation of levels at 695, 830, 1385, and 1415 kev. The Fermi plot of the beta spectrum of ^{129m}Te studied with a Siegbahn-Slätis spectrometer showed beta groups with end-point energies of 1595, 1452, 976, and 690 kev. From beta-gamma coincidence measurements it was concluded that 1595 kev is the end-point energy of the beta transition from ^{129m}Te to the ground state of ^{129}I while 1452 kev is the end-point energy of the beta transition from the 70-min activity to the 27-kev level. Comparison of the total intensities of the beta transitions from ^{129m}Te and ^{129}Te showed that the isomeric transition takes place with a branching ratio of 0.64. The log ft values for the various beta groups were found from their relative intensities and spin assignments to various levels were made on this basis. (auth)

21286 GYROMAGNETIC RATIO OF THE 4^+ STATE OF Ce^{140}. M. Schmorak, H. Wilson, P. Gatti, and L. Grodzins (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 134: B718-21(May 25, 1964). (TID-19915)

The gyromagnetic ratio g of the 2083-kev 4^+ state in ^{140}Ce was measured by precessing the γ-γ angular correlation through this state in a magnetic field. The value obtained for the g factor was 0.95 ± 0.10. This result indicates that the 4^+ state is essentially a 2 proton $g_{\frac{7}{2}}$, $d_{\frac{5}{2}}$ configuration. The angular correlation results are consistent with the accepted decay scheme. The ionic state of Ce following the β decay of La is discussed. (auth)

21287 SYMMETRY ENERGY AND THE ISOTOPIC SPIN DEPENDENCE OF THE SINGLE-PARTICLE POTENTIAL IN NUCLEAR MATTER. Keith A. Brueckner and Janusz Dabrowski (Univ. of California, San Diego, La Jolla). Phys. Rev., 134: B722-30(May 25, 1964).

Nuclear matter with a given neutron excess is treated within the frame of the K-matrix theory. General expressions for the symmetry energy ϵ_{sym} and the single-particle potential are obtained with the help of the reaction matrix that depends on two different Fermi momenta for neutrons and protons. In particular, an expression for the isotopic spin-dependent part U_1 of the single-particle potential is obtained, and then specialized for single particles at the Fermi surface. With suitable approximations, numerical values of ϵ_{sym} and U_1 at the Fermi surface are obtained with the help of the Bruckner-Gammel solution for nuclear matter. The results are: $\epsilon_{sym} = 64$ Mev, $U_1(k_F) = 126$ Mev. (auth)

21288 DECAY OF Cd^{117}. R. P. Sharma, K. P. Gopinathan, and S. R. Amtey (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 134: B730-9(May 25, 1964).

The ^{117}Cd activity produced by (n,γ) reaction on ^{116}Cd was found to decay with a half life of ~3 h indicating that the possible isomer also has a half life almost equal to that of the ground state. The presence of such an isomer was established by beta-gamma coincidence measurements. The highest energy beta group as studied in the intermediate image beta-ray spectrometer showed an end point of 2250 kev. The singles gamma spectrum was complex in nature and extended up to 2450 kev. Beta-gamma and gamma-gamma coincidence studies revealed 29 gamma transitions and eight beta groups belonging to the decay of both activities of ^{117}Cd. Based on these and the results of sum coincidence and total absorption studies a decay scheme with levels in ^{117}In at 310, 590, 660, 750, 880, 1070, 1410, 1700, 1890, 1980, 2120, 2320, and 2450 kev is proposed. Possible spins and parities for these levels are discussed. (auth)

21289 NUCLEAR ENERGY STATES OF In^{115}. D. D. Bornemier, L. D. Ellsworth, C. E. Mandeville, and V. R. Potnis (Kansas State Univ., Manhattan). Phys. Rev., 134: B740-2(May 25, 1964).

The gamma rays of ^{115}Cd and ^{115m}Cd were investigated by means of scintillation counting and coincidence methods. The K-shell conversion coefficient of the 34-kev gamma ray is measured to be 3.43 ± 0.12, suggesting the transition to be E1 in character and that the 858-kev level in the nucleus of ^{115}In has positive parity. The gamma rays at 635, 650, and 890 kev that are reported in the decay of ^{115m}Cd are shown to emanate from ^{110m}Ag, present as an impurity. (auth)

21290 MÖSSBAUER EFFECT IN Tm^{169} AND TOTAL INTERNAL CONVERSION OF THE 8.42-kev TRANSITION. E. Kankeleit, F. Boehm, and R. Hager (California Inst. of Tech., Pasadena). Phys. Rev., 134: B747-51(May 25, 1964).

The absolute yield of the Mössbauer absorption of the 8.42-kev transition in ^{169}Tm was determined for a thulium oxide and a thulium metal absorber. The 8.42-kev gamma ray was resolved from the L x rays of erbium by means of a flat lithium fluoride crystal diffraction spectrometer. From the observed Mössbauer absorption effect the total conversion coefficient $\alpha_{tot} = 325 \pm 35$ and the magnetic transition rate of $B(M1, \frac{3}{2} \rightarrow \frac{1}{2}) = 5.1 \times 10^{-2}$ $(e\hbar/2Mc)^2$ was derived. (auth)

21291 (p,d) REACTIONS ON NUCLEI FROM V TO Ni. J. C. Legg and E. Rost (Princeton Univ., N. J.). Phys. Rev., 134: B752-64(May 25, 1964). (PUC-1963-120)

Pickup (p,d) reactions on ^{51}V, ^{52}Cr, ^{55}Mn, ^{54}Fe, ^{56}Fe, ^{57}Fe, ^{58}Fe, ^{59}Co, ^{58}Ni, and ^{60}Ni were studied using 17.0- and 18.5-Mev protons. The experimental results were analyzed using the predictions of a direct-reaction model using distorted waves. The distorted-wave theory predicted quite accurately the dependence of cross section on bombarding energy, while the plane wave theory failed in that respect. The ground states of ^{51}V, ^{52}Cr, and ^{54}Fe were found to have almost pure $(1f_{\frac{7}{2}})^8$ neutron configurations, thus furnishing more evidence that the $1f_{\frac{7}{2}}$ neutron shell is a major shell. The results for the heavier nuclei indicate a strong mixing of $1f_{\frac{7}{2}}$ and 2p neutrons in the ground state. The spin assignments obtained for a few levels are in disagreement with γ-ray angular correlation measurements. (auth)

21292 STUDIES OF ELASTIC SCATTERING OF PROTONS, DEUTERONS, AND ALPHA PARTICLES FROM ISOTOPES OF Cu, Ni, AND Fe. L. L. Lee, Jr., and J. P. Schiffer (Argonne National Lab., Ill.). Phys. Rev., 134: B765-72(May 25, 1964).

Angular distributions of elastically scattered protons were measured at bombarding energies of 7, 8, 9, 10, 11, and 12 Mev from enriched isotopic targets of ^{58}Ni, ^{60}Ni, ^{63}Cu, and ^{65}Cu. The angular distributions of 12-Mev elastically scattered protons, deuterons, and alpha particles were measured from targets of ^{58}Ni, ^{60}Ni, ^{62}Ni, ^{64}Ni, ^{63}Cu, ^{65}Cu, and ^{54}Fe. The range of angles measured was between 20 and 169°. Absolute cross sections are believed to be accurate to about 5%, the relative measurements to 2.5%. The measured angular distributions are compared with ones calculated from optical-model potentials. For the proton scattering, the sensitivity of such data to a symmetry term in the potential and to the dependence of the potential on incident proton energy was also investigated and the results are compared with the ones arrived at by Perey. (auth)

21293 $C^{12}(\pi^-,\pi^-n)C^{11}$ EXCITATION FUNCTION. A. M. Poskanzer and L. P. Remsberg (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 134: B779-82(May 25, 1964). (BNL-7687; CONF-439-1)

The $^{12}C(\pi^-,\pi^-n)^{11}C$ excitation function was measured with incident pions of energies from 0.45 to 1.9 Bev. The excitation function of this simple nuclear reaction shows effects of the elementary pion-nucleon resonances. The $\pi^- - n$ resonances tend to be reproduced in the excitation function, while the $\pi^- - p$ resonances tend to cause a reduction in the cross sections. The production of ^{11}C and ^{18}F by π^- interactions with Al targets was also studied over the same energy range. These excitation functions do not exhibit any structure. (auth)

21294 RECOIL RANGE MEASUREMENTS OF REACTIONS INDUCED IN Ni^{58} WITH 46- TO 68-Mev HELIUM IONS. Marshall Blann and Alan Ewart (Univ. of Rochester, N. Y.). Phys. Rev., 134: B783-93(May 25, 1964).

Ranges in ^{58}Ni are reported for ^{56}Ni, ^{57}Ni, ^{55}Co, ^{56}Co, ^{57}Co, and ^{58}Co recoil ions resulting from the bombardment of ^{58}Ni with 46- to 68-Mev helium ions. The thick target-thick catcher method was used to obtain average recoil ranges in the beam direction. Measured ranges were compared with theoretical range predictions, calculated assuming full momentum transfer from the incident helium ions to the recoil ions. Theoretical range curves were corrected for the influence of α particle and nucleon evaporation. Experimental ranges measured from reaction thresholds to excitation function peaks agree with the corrected theoretical curves to within 10%. Recoil ranges for ^{57}Co and ^{57}Ni are shown to have predominate contributions from a low-momentum-transfer process in the energy range corresponding to the high-energy tail of the excitation functions. At higher energies the ranges and ex-

citation functions are shown to increase, consistent with contributions from the onset of ^{58}Ni (α,5-nucleon) compound-nucleus reactions. Recoil ranges for ^{55}Co, ^{56}Co, and ^{58}Co are consistent with full momentum transfer over the entire energy range studied, including those ranges corresponding to the high-energy tail of the ^{56}Co excitation function. Recoil ranges for ^{56}Ni are consistent with full momentum transfer up to the peak of the excitation function, after which the range decreases sharply as a competing low momentum-transfer reaction becomes predominant. The details of the reaction mechanism responsible for the high-energy tails of the ^{57}Ni, ^{57}Co, and ^{56}Ni excitation functions are discussed. In the case of the tail of the excitation-function for the formation of ^{56}Ni, evidence is presented that the interaction is between the incident helium ion and one or two neutrons, rather than an (α,α') inelastic scattering followed by nucleon evaporation. It is concluded that differentiation between these two mechanisms in the case of the reactions forming ^{57}Ni and ^{57}Co is impossible. (auth)

21295 DIFFERENTIAL CROSS SECTIONS FOR THE REACTION $C^{13}(Li^6,\alpha)N^{15}$. J. M. Blair, Pham-Dinh-Lien, and Russell K. Hobbie (Univ. of Minnesota, Minneapolis). Phys. Rev., 134: B793-5(May 25, 1964).

Differential cross sections were measured for the reaction $^{13}C(^6Li,\alpha)^{15}N$ with the residual nucleus in its ground and first two excited states, the bombarding energy ranging from 3.4 to 4.0 Mev. General features suggest a direct interaction. (auth)

21296 DELAYED GAMMAS FROM FAST-NEUTRON FISSION OF Th^{232}, U^{233}, U^{235}, U^{238}, AND Pu^{239}. Philip C. Fisher and Leon B. Engle (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 134: B796-816(May 25, 1964). (LADC-4730)

Results of an experiment are presented in which the energy- and time-dependence of gammas emitted after instantaneous fast-neutron-induced fission of ^{232}Th, ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu were measured. Gammas having energies between 0.12 and 6.5 Mev were detected during five short time intervals between 0.2 and 45.0 sec after fission occurred. The measured spectra and seventeen bin distributions of the absolute number of photons/fission-sec-Mev and intercomparisons and integrations over energy and time of these distributions are given. The rate of energy emission from the products of ^{232}Th + n was found to be 4.5 times higher than that from ^{239}Pu + n during the first time interval after fission. Delayed gamma spectra from the products of ^{232}Th + n are noticeably harder than those from ^{239}Pu + n during all five time intervals measured. The several uranium isotopes' behavior is intermediate to that of the products of ^{232}Th + n and ^{239}Pu + n, in both rate of energy emission and hardness of energy spectra. The significant differences in the measured characteristics of the delayed gammas from the five fissionable isotopes permit the isotopes to be arranged in a sequence. Approximate position in the sequence depends on the average displacement of the initial fragment distribution from fission. It appears possible to predict approximate values of delayed neutron yield, which Keepin has shown to also depend on the average displacement of the intial fragment of distribution from fission, of other fissionable isotopes on the basis of delayed gamma measurements. (auth)

21297 BETA DECAYS AND DELAYED GAMMAS FROM FISSION FRAGMENTS. James J. Griffin (Los Alamos Scientific Lab., N. Mex.). Phys. Rev., 134: B817-23(May 25, 1964).

A theoretical study is made of the gross behavior of beta decays following nuclear fission in times from 10^{-2} to 10 sec. First a simple model is formulated to describe the situation in terms of a few parameters. Then the most uncertain of these parameters are chosen to fit the observed rate of delayed gamma emission (assumed proportional to the beta-decay rate) for the ^{235}U(n,f) process. The description is extended to other isotopes by assuming that they differ only by small shifts of their initial fragment distributions away from that appropriate to neutron-induced fission of ^{235}U. The result is a theoretical summary of the presently available data that can be used in predictive extrapolation of that data to situations not yet studied experimentally. (auth)

21298 DELAYED GAMMA RAYS FROM PHOTOFISSION OF U^{238}, U^{235}, AND Th^{232}. R. B. Walton (General Atomic Div., General Dynamics Corp., San Diego, Calif.), R. E. Sund, E. Haddad, J. C. Young, and C. W. Cook. Phys. Rev., 134: B824-32(May 25, 1964).

Absolute delayed gamma intensities from the photofission of ^{238}U, ^{235}U, and ^{232}Th were measured as a function of time after bursts of fissions produced by the bombardment of samples with 20-Mev x rays from an electron linear accelerator. For all three target nuclei, components of short-lived gamma rays, which are attributed to the decay of isomers formed either in fission or, less likely, by other photoreactions, contributed markedly to the gamma-ray activity for times up to 800 μsec after the beam pulse. Beyond 800 μsec the gamma-ray activity decreased little for times up to about 10^{-1} sec. The gamma rays emitted in this interval, the "plateau" region, and at longer times are believed to follow beta decay of fission fragments. In the "plateau" region, the absolute intensities of gamma rays ($E_\gamma > 0.51$ Mev) from the photofission of ^{238}U, ^{235}U, and ^{232}Th are 0.70, 0.26, and 0.35 photons/fission-sec, respectively. After 0.1 sec the gamma-ray decay curves have the same shapes as those observed by other investigators in neutron fission of the same target nuclei, but the absolute intensity from photofission is approximately a factor of two less than that from neutron fission. (auth)

21299 J DEPENDENCE OF THE ANGULAR DISTRIBUTIONS FROM (p,d) REACTIONS AT 28 Mev. R. Sherr (Princeton Univ., N. J.), E. Rost, and M. E. Rickey. Phys. Rev. Letters, 12: 420-3(Apr. 13, 1964).

A strong dependence of the shape of the forward-angle maxima on the J of the final state following pickup of an $l = 3$ neutron from a spin-zero target was found in an investigation of the (p,d) reactions at 28 Mev. Elements ranging from Ti through Ni were studied. The deuteron spectra from ^{56}Fe, ^{58}Fe, ^{58}Ni, ^{60}Ni, and ^{62}Ni targets are shown along with cross sections and spin assignments. Angular distributions for $l = 3$ pickup to $\frac{5}{2}^-$ and $\frac{7}{2}^-$ states are given. Experimental results are compared with distorted-wave calculations. (L.B.S.)

21300 POLARIZATION OF PROTONS SCATTERED FROM ^{12}C. L. Drigo, C. Manduchi, G. C. Nardelli, M. T. Russo-Manduchi, and G. Zannoni (Università, Padua and Istituto Nazionale di Fisica Nucleare, Padua). Phys. Rev. Letters, 12: 452-4(Apr. 20, 1964).

Polarization of protons elastically scattered by carbon-12 at 4.32 to 4.43 Mev is investigated. Definition of details of energy-angle variations is attempted. (M.J.T.)

21301 SPIN DEPENDENCE OF (d,t) $l_n = 1$ ANGULAR DISTRIBUTIONS IN Ni AND Fe. R. H. Fulmer and W. W. Daehnick (Univ. of Pittsburgh). Phys. Rev. Letters, 12: 455-6(Apr. 20, 1964).

Angular distributions from (d,t) reactions on iron-56 and nickel-60 and -61 at 14.7 Mev were used to distinguish between the $p_{\frac{1}{2}}$ and $p_{\frac{3}{2}}$ states of these nuclei. (M.J.T.)

21302 METHOD OF STUDY OF HIGH-ENERGY SCATTERING EVENTS WITH VERY SMALL ENERGY LOSSES. Robert Hofstadter (Stanford Univ., Calif.). Phys. Rev. Letters, 12: 495-6(Apr. 27, 1964).

A method using an accelerator and thin targets is suggested for investigating very small energy losses in high-energy electron or proton scattering events. (C.E.S.)

21303 CLASSIFICATION OF EXCITED STATES OF EVEN-EVEN NUCLEI. S. M. Brahmavar and M. K. Ramaswamy (Karnatak Univ., Dharwar, India). Proc. Indian Acad. Sci., Sect. A, 59: 102-14(Feb. 1964).

The possible usefulness of the product AE (mass number times excitation energy) in classifying excited states of even-even nuclei is discussed. A table of E and AE for even-even nuclei having 0^+, 2^+, $0^{+\prime}$, $2^{+\prime}$, 3^-, and 5^- levels is given. It is shown that this criterion may be useful in understanding the excitation mechanism. (M.J.T.)

21304 APPROXIMATION METHOD IN COLLISION THEORY BASED ON R-MATRIX THEORY. C. B. Duke and E. P. Wigner (Princeton Univ., N. J.). Rev. Mod. Phys., 36: 584-9(Apr. 1964).

An approximation method for numerical calculations of scattering and reaction cross sections is described. An R matrix calculated with the first Rayleigh-Schroedinger approximation for the resonant energies and reduced widths is used. Simple potential well scattering is considered as an example. This method is compared with the Born approximation method, and the regions of validity are discussed. (M.J.T.)

21305 PHYSICAL REGIONS IN INVARIANT VARIABLES FOR n PARTICLES AND THE PHASE-SPACE VOLUME ELEMENT. N. Byers (Univ. of California, Los Angeles) and C. N. Yang. Rev. Mod. Phys., 36: 595-609(Apr. 1964).

The reactions $A \rightarrow 1 + 2 + \ldots + n$ and $A + \bar{1} \rightarrow 2 + 3 + \ldots + n$ are studied. Letting $\{i,j\}$ be the scalar product of the 4-momenta of particles i and j, the kinematically allowed values of $\{i,j\}$ and the Lorentz-transformation-inequivalent kinematic configurations for the reactions are considered. An expression for the volume element $d\tau_{n,4} = (\pi d^4 p_i)[\pi\delta(p_i^2 - m_i^2)]\delta^4[(\Sigma p_i) - p_A]$ in terms of $\{i,j\}$ is derived, seeking where possible expressions symmetric in i,j. (M.J.T.)

21306 THE UNIVERSAL FERMI INTERACTION AND THE CONSERVED VECTOR CURRENT IN BETA DECAY. C. S. Wu (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). Rev. Mod. Phys., 36: 618-32(Apr. 1964).

The theoretical formulation of the (V − A) fermi interaction is shown. The requirements of the continuity equation of the electromagnetic current are discussed in order to lead to the formulation of the conserved vector current theory and the unique properties arising from it. The present status of the question of equality between the vector coupling constant g_v of beta decay and the Fermi constant g_μ of μ decay is examined. Four types of experiments to test the CVC hypothesis are discussed. (auth)

21307 ON THE EQUILIBRIUM FORM OF LIGHT NUCLEI. B. I. Tishchenko, A. A. Kresnin, and A. V. Shebeko (Inst. of Physics and Tech., Kharkov). Ukr. Fiz. Zh., 8: 1185-92(1963). (In Ukrainian)

The problem of the motion of nucleons in a nonaxial oscillator potential is considered within the confines of the generalized nuclear model, taking into account the spin-orbital interaction and the Nilsson interpolation term. The values of the one-particle energy levels of light nuclei with $A \leq 16$ were obtained, and the parameters of deformation β and γ were calculated for these nuclei. The question of the dependence of the deformation parameters on the change in the parameter of the spin-orbital interaction κ and Nilsson's parameter μ is considered. (auth)

21308 MEASUREMENT OF PHOTONEUTRON YIELDS FROM TARGETS OF GREAT THICKNESS. I. A. Grishaev, D. I. Sikora, B. I. Shramenko, and V. A. Shkoda-Ulyanov. Ukr. Fiz. Zh., 8: 1193-8(1963). (In Ukrainian)

A procedure was developed for measuring photoneutron yields from targets of great thickness by the method of induced activity. The dependence of the photoneutron yields on the electron energy, on ^{16}O nuclei over an energy range of 19 to 66 Mev, and on ^{63}Cu nuclei over an energy range of 13 to 50 Mev was investigated. The electron beam from a linear accelerator was monitored by means of a secondary emission monitor. The measured values of the photoneutron yields agree with the data of others; they proved to be half the calculated values obtained by means of the Belenky-Tamm equilibrium spectrum. (auth)

21309 CIRCULAR POLARIZATION OF γ QUANTA EMITTED BY ATOMIC NUCLEI AFTER β DECAY. I. V. Estulin and A. A. Petushkov. Usp. Fiz. Nauk, 82: 253-85 (Feb. 1964).

Using the quantum treatment, the circular polarization of γ radiation was related to the projection of the spin of the γ quantum in the direction of its impulse; the orientation of the projection was dependent on its direction. If the probabilities of the orientations are equal, no polarization occurs. Circularly polarized quanta are emitted by polarized nuclei; in the simplest case the spin of the original polarized nucleus if $j_1 = 1$ and after radiative transition it becomes zero, $j_2 = 0$. Circular polarization of γ quanta after β decay is due to the nonconservation of parity in weak interactions. Lee and Yang considered the possibility of measuring the circular polarization of the γ quanta accompanying β decay in order to examine the nonconservation of parity but they assumed that the experimental difficulties are too high. The whole problem and its treatment in the literature are reviewed within the framework of permissible transitions. The available data on circular polarization of a number of isotopes are tabulated. These studies made it possible to determine the absolute values and the phase relationships of the matrix elements. (Review article, 100 references). (TTT)

21310 THE RADIATIVE CAPTURE OF μ MESON BY NUCLEI. Li-ning Chang and Yuam-beng Dai. Wu Li Hsueh Pao, 17: 41-4(Jan. 1961). (In Chinese)

The probability of radiative capture of a meson(μ^-) by a nucleus and the polarization of the emitted photon in this process is calculated by assuming a Fermi gas-model for the nucleus. The effect of virtual pions is taken into account in the calculation. The contribution of the Feynman diagram, corresponding to the emission of photon by a virtual particle is treated through considerations of gauge invariance. (auth)

21311 THE DIRECT PRODUCTION OF ELECTRON PAIRS BY HIGH-ENERGY CHARGED PARTICLES. Ao Wang, Ho-nian Lu, Er-chih Chen, and Chien Hsiao. Wu Li Hsueh Pao, 17: 263-72(June 1961). (In Chinese)

An experiment using a cloud chamber in a magnetic

field of 6200 gauss to determine the average total cross section of the direct production of electron pairs in aluminum by high energy electrons generated in cascade showers and having energies larger than 30 Mev is described. After correction for the spurious events 8.1 electron tridents, which were produced actually by electrons, were found. This figure corresponds to a mean free path of 672 ± 585 cm or an average total cross section of (0.25 ± 0.22) × 10^{-25} cm^2 for trident production. In the treatment of data, the elimination of spurious tridents was appropriately considered. The formulas of the total cross section derived by Bhabha and by Murota et al., were applied in accordance with the experimental conditions to compute the total cross section. Comparison between the theoretical and experimental values was made. The experiment is in fair agreement with the theory of Murota et al., while not in contradiction with that of Bhabha. (auth)

21312 ROTATIONAL ENERGY LEVELS OF ODD-ODD Tb^{160}, Ta^{182}, Re^{186}, AND Re^{188}. Yung-tsung Sung and Kuo-kuan En. Wu Li Hsueh Pao, 17: 287-9(June 1961). (In Chinese)

21313 CONSTRUCTION OF AN AUTOMATICALLY OPERATED $\pi\sqrt{2}$ SPECTROMETER AND INVESTIGATION OF THE CONVERSION LINE SPECTRA OF ^{114m}In AND ThB WITH DAUGHTER PRODUCTS. H. Daniel and G. Luehrs (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 176: 30-44(1963). (In German)

An automatically operated $\pi\sqrt{2}$ spectrometer is described. The regulated current supply is transistorized. With this spectrometer the electron spectra of ^{114m}In and of ThB with daughter products were investigated. The K/L ratio of the 191-kev isomeric transition in ^{114m}In was found to be 1.25 ± 0.03, in excellent agreement with the theoretical value of SLIV and BAND. In the electron spectrum of the ThB and daughter products 46 lines were found between Bρ = 1750 and 10000 Γ cm. A new line was observed at Bρ = 7030 Γ cm, which fixes a level at E = 1.807 Mev in ThC′ (^{212}Po). Simultaneously the earlier reported discrepancy between electron and γ intensities for 1.8 Mev transition energy was resolved. There was an E0 transition of 1.800 Mev while the new line was the K conversion line of a new radiative transition (most probably M2). A spin of I = 2+ was assigned to the 1.680-Mev level of ThC′. The 0.953-Mev transition from this level is M1, with E0 admixture. (auth)

21314 ON THE NUCLEAR QUADRUPOLE MOMENT OF ^{87}Rb. H. Bucka, H. Kopfermann, M. Rasiwala, and H. Schuessler (Universität, Heidelberg). Z. Physik, 176: 45-6(1963). (In German)

With the help of the double resonance technique, the hyperfine structure of the ^{9}Rb isotope in the excited 5 $^{2}P_{\frac{3}{2}}$ level of the rubidium spectra is given. The nuclear quadrupole moment was calculated to be 0.144 × 10^{-24} cm^2 without regard to the Sternheimer correction and 0.120 × 10^{-24} cm^2 considering the correction. (M.C.G.)

21315 BROADENING OF THE MÖSSBAUER LINE FOR GAUSSIAN SPECTRA. S. Margulies (Max-Planck-Institut für Kernphysik, Heidelberg). Z. Physik, 176: 63-6(1963).

A procedure described by Bykov and Hien was employed to obtain an approximation formula for the line broadening expected in a Mössbauer experiment for the case where the emission and absorption spectra have Gaussian shapes. For identical emission and absorption spectra, the broadening as given by this formula has an error of less than 4.5% for effective absorber thicknesses up to $T_A = 10$. The case where the emission and absorption spectra have different half widths was also considered. (auth)

21316 THE POSITION DISTRIBUTION OF MEDIUM-FAST ELECTRONS IN MULTIPLE SCATTERING. Klaus Jost and Joachim Kessler (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 176: 126-42(1963). (In German)

The angular distribution of plurally scattered electrons was previously investigated by several authors, but no experimental investigations in the range of plural scattering were known about the distribution of linear displacements. Therefore electrons (40 to 130 kev) were shot in extended gaseous targets (He, Ne, Ar, Kr, Xe, and O_2) of low pressure and the resultant distribution of the current density at the end of the target was measured by means of the p-n junction of a gallium arsenide cell. The measurements in argon were compared with theoretical calculations. It is shown by some examples how to obtain from the measurements at the end of the target the electron distribution inside the target. (auth)

21317 SPIN DETERMINATION OF THE GROUND STATE OF ^{203}Hg. B. Faldum (Universität, Giessen, Ger.). Z. Physik, 176: 159-67(1963). (In German)

By Compton scattering on magnetically saturated iron, the degree of circular polarization, P_c, of the β particle from ^{203}Hg followed by the 279-kev gamma quanta of ^{203}Tl was measured. From the value $P_c = -0.23 \pm 0.12$ and $\bar{v}/c = 0.62$, the anisotropic coefficient $A = -0.37 \pm 0.19$ was obtained. By comparison between theory and experiment, from the three possible spin values of the ground state of ^{203}Hg ($\frac{1}{2}$, $\frac{3}{2}$, $\frac{5}{2}$), the value $\frac{1}{2}$ was excluded. The values $\frac{3}{2}$ and $\frac{5}{2}$ were both possible on the basis of the measurement, however, according to theoretical consideration the value $\frac{5}{2}$ is given preference. (tr-auth)

21318 SCATTERING OF Li^+ IONS ON RARE GASES. H. Boersch and G. Forst (Technische Universität, Berlin). Z. Physik, 176: 221-5(1963). (In German)

The angular distribution of $^{7}Li^+$ ions (7 to 60 kev) scattered by rare gas atoms (He, Ne, Ar, Kr, Xe) showed 3 to 5 characteristic maxima of intensity, which were not observed when electrons of equal energy were scattered by the same atoms. The existence of the maxima can be explained by polarization of the scattering rare gas atoms by the $^{7}Li^+$ ions. (auth)

21319 THE β DECAY ENERGY OF THE TECHNETIUM ISOTOPES ^{103}Tc, ^{104}Tc, AND ^{105}Tc. P. Kienle, K. Wien, U. Zahn, and B. Weckermann (Technische Hochschule, Munich). Z. Physik, 176: 226-36(1963). (In German)

Molybdenum fission products from uranium were rapidly separated using a sublimation technique. Their technetium daughters could be separated from the molybdenum sample by a second sublimation. The decay of ^{103}Tc, ^{104}Tc, and ^{105}Tc was investigated using scintillation counters and coincidence methods. ^{103}Tc decays by the emission of two β groups at energies of 2.0 and 2.2 Mev followed by γ lines of 135, 215, and 350 kev. According to a proposed decay scheme ^{103}Tc decays with a Q-value of 2.35 ± 0.10 Mev into ^{103}Ru. ^{105}Tc emits a β group of about 3.4 Mev maximum energy followed by a 110 kev γ transition. The Q-value of the ^{105}Tc decay was estimated to be 3.4 ± 0.2 Mev. From β-γ and γ-γ coincidence spectra of ^{104}Tc four β-γ-γ cascades could be identified, which populate excited states of 0.36, 0.89, 2.5, 3.5, and 4.05 Mev in ^{104}Ru. The Q-value of the ^{104}Tc decay was found to be 5.85 ± 0.10 Mev. The Q-values and spin assignments of the ground states of ^{103}Tc and ^{105}Tc are discussed in a more detailed β decay system. (auth)

21320 A NEW METHOD FOR DETERMINATION OF THE L-FLUORESCENCE YIELD OF DYSPROSIUM. T. Zimmerli and A. Flammersfeld (Universität, Göttingen, Ger.). Z. Physik, 176: 323-8(1963). (In German)

A method was developed to measure the L-fluorescence yield of Dy. With the aid of a proportional counter and an anthracene-crystal spectrometer, the L x-ray and the conversion electron spectra of ^{165m}Dy were measured. From the intensities thus evaluated, together with the known conversion coefficients, the mean L-fluorescence yield was calculated. It was found to be $\omega_L = 0.14 \pm 0.02$. Moreover the partial fluorescence yield of the L_{III}-subshell could be evaluated: $\omega_{L_{III}} = 0.145 \pm 0.055$. (auth)

21321 INVESTIGATION OF THE ELECTRIC HYPERFINE STRUCTURE INTERACTION IN HAFNIUM AMMONIUM HEXAFLUORIDE SINGLE CRYSTALS BY γ-γ ANGULAR CORRELATION MEASUREMENTS. L. Mayer, E. Bodenstedt, and C. Guenther (Universität, Hamburg and Universität, Bonn). Z. Physik, 177: 28-53(1964). (In German)

The angular correlation of the 133 to 482 kev γ-γ cascade in the decay of ^{181}Hf is strongly attenuated if solid sources of hafnium ammonium hexafluoride are used. The unperturbed correlation was observed however when a single crystal of hafnium ammonium hexafluoride was used whose main axis pointed into the direction of one of the two detectors. This proved that the perturbation is static and that the maximum component of the electric field gradient at the position of the hafnium nucleus coincides with the direction of the main axis of the crystal. The anisotropy of the angular correlation was measured as a function of the direction of the crystal axis. The results agreed with the theoretical predicted functions for a strong electric quadrupole interaction. Then the intrinsic electric field was combined with an external magnetic field. The magnetic field direction was chosen parallel to the z-axis of the electric field gradient and perpendicular to the plane of the detectors. The theory for axially symmetric field gradients predicts a maximum of the anisotropy of the angular correlation for a magnetic field strength at which resonance exists between electric and magnetic precession. For a strong electric interaction the maximum anisotropy has half the value of the unperturbed correlation. In this case the electric quadrupole interaction was so strong that the resonance was not reached even when external magnetic fields up to 48000 gauss were applied. The observed anisotropies were too large however to be fitted by theoretical curves, which were calculated under the assumption that the field gradient has axial symmetry. Therefore the theory for non-axially symmetric electric field gradients was developed. A fit was possible with it and unique solutions were obtained for the strength of the electric hyperfine interaction as well as for the asymmetry coefficient of the electric field gradient tensor. The accuracy of these results was not very high but the strength of the electric hyperfine interaction was found to be small enough to make a direct observation of the electric spin rotation by the differential angular correlation method possible. The observed pattern confirmed the non-axially symmetry of the electric field gradient and the following parameters were derived: $\omega_{E_q} = (570 \pm 30)$ MHz (ω_{E_q} = electric interaction frequency = $(6eQ \cdot |V_{zz}|)/[4I \cdot (2I-1) \cdot \hbar]$ and $\eta = 0.43 \pm 0.04$ (η = asymmetry parameter = $(V_{xx}-V_{yy})/(V_{zz})$). As the hafnium nucleus is strongly deformed, a value for the electric quadrupole moment of the 482-kev state can be derived from coulomb excitation work. Using Q(482 kev) = $(2.45 \pm 0.1) \times 10^{-24}$ cm^2 the following absolute values for the electric field gradient tensor components were obtained: $V_{xx} = \mp (1.0 \pm 0.1) \times 10^{17}$, $V_{yy} = \mp (2.6 \pm 0.2) \times 10^{17}$, and $V_{zz} = \pm (3.6 \pm 0.2) \times 10^{17}$ v/cm^2. (auth)

21322 CALCULATION OF ELECTRON-PHOTON CASCADES ACCORDING TO THE MONTE CARLO METHOD. W. Woischnig and H. Burmeister (Technische Hochschule, Aachen). Z. Physik, 177: 151-6(1964). (In German)

Using the Monte-Carlo method linear electron-photon showers in lead were calculated for primary electron and photon energies of 100, 200, and 380 Mev. It was found that, beyond the maximum, the slope of the shower curves depends on the primary energy as well as on the cut-off energy of the electron and photon spectra. This behavior is in agreement with experimental data. (auth)

21323 COMPARISON OF THE DAVYDOV THEORY WITH THE MODEL OF THE AXIAL-SYMMETRIC TOP WITH ROTATION-VIBRATION INTERACTION FOR DEFORMED e-e NUCLEI. Amand Faessler and Walter Greiner (Universität, Freiburg i. B.). Z. Physik, 177: 190-205(1964). (In German)

For deformed even-mass nuclei the model of the axial-symmetric vibrating top with rotation-vibration interaction was compared to the Davydov model without and with a β band. The E2 transition probabilities were calculated. The coefficients B_{zc} and C from $E = A\,I(I+1) - B_{zc}I^2(I+1)^2 + C\,I^3(I+1)^3$ were obtained. For the transition probabilities from the states of the γ band to the states of the ground state band as well as for B and C the Davydov model yielded values only about half of those obtained from the rotation-vibration theory. A comparison with available experimental data was made. In the rotation-vibration model the agreement was better than in the Davydov theory. (auth)

21324 RELATIVE MEASUREMENT OF ELECTRON POLARIZATION FOR β DECAY: RaE(Bi^{210})-P^{32}. Gerd Schatz, Heinigerd Rebel and Wolfgang Buehring (Universität, Heidelberg). Z. Physik, 177: 495-513(1964). (In German)

An appartus is described for comparing the longitudinal polarization values P of β particles from different emitters by the method of double scattering. For RaE(^{210}Bi) and ^{32}P the ratio of polarization values was measured to be P(RaE)/P(^{32}P) = 0.757 ± 0.022 at 540 kev. This was in good agreement with previous measurements. Ratios of matrix elements were determined from polarization and spectrum shape data of RaE, but these values were not reliable because the spectrum shape showed a systematic discrepancy between theory and experiment below 200 kev. A discussion of electron polarization and spectrum shape data of ^{32}P showed that deviations of polarization from the allowed value are probably very small. (auth)

21325 INVESTIGATION OF THE REACTION $Si^{28}(\gamma,p)Al^{27}$. H. Ullrich (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Z. Physik, 177: 514-28(1964). (In German)

A silicon semiconductor detector was irradiated with betatron bremsstrahlung of different end point energies and the energy distributions of the protons originating in the detector itself by the reaction $^{28}Si(\gamma,p)^{27}Al$ were measured with good statistical accuracy. The end point energies were varied in 1-Mev steps from 15 to 30 Mev. Using the known spectral distribution of the γ rays the energy dependence of the total cross section of the studied reaction could be derived from the measured proton spectra. The resulting cross section showed a peak at 20.5 Mev and a half width of 4 Mev. Approximate values

for the branching ratios for transitions to excited states of the residual nucleus could also be obtained. (auth)

21326 THE INDUCED PSEUDOSCALAR INTERACTION AND THE μ-CAPTURE IN He^3. Wolfgang Drechsler and Berthold Stech (Universität, Heidelberg). Z. Physik, 178: 1-10(1964).

Measurements of μ capture in ^3He as well as the determination of the electric and magnetic form factors of ^3He and ^3H allowed a detailed analysis of the μ-capture process in ^3He. Assuming only the theory of a conserved vector current these experiments could be used to derive a relation for the axial vector part of the $^3He \rightarrow {}^3H$ transition amplitude. This result was compared with a nuclear physics calculation of the form factors. It followed that the induced pseudoscalar coupling constant for the muon capture on a free proton has a sign in agreement with the value predicted by Goldberger and Treiman. Its magnitude seemed to be somewhat larger than the predicted value. Qualitative agreement with an extension of Nambu's idea of an almost conserved axial vector current to the case of the $^3He \rightarrow {}^3H$ transition was also found. (auth)

21327 THE LOW EXCITATION DEGREE OF THE ^{23}Na NUCLEUS ACCORDING TO THE COLLECTIVE MODEL. W. Gloeckle (Technische Hochschule, Stuttgart). Z. Physik, 178: 53-63(1964). (In German)

An experiment was undertaken in order to use the collective model for stable, deformed nuclei for the first seven excited states of ^{23}Na. It succeeded in projecting the experimental location of the levels, in confirming the experimental spins, and in predicting some missing spins. In addition, four rotation bands were mixed and were considered together with deep-lying inside excitation possibilities, which permit the Nilsson model. The relative locations of the K-band and the coupling constant could be inferred in an adequate way from the Nilsson model. For the adaptation only a moment of inertia was used, which was somewhat smaller than the hydrodynamic estimate. (tr-auth)

21328 PRODUCTION OF ^7Be BY NUCLEAR PHOTOEFFECT ON BERYLLIUM, BORON, AND CARBON. H. Artus, G. Fricke, and D. E. von Stein (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 178: 109-12 (1964). (In German)

Beryllium, natural boron, boron enriched with ^{10}B, and graphite were irradiated with 44- and 56.5-Mev bremsstrahlung. The yields of ^7Be from each of these targets were measured by comparison with the $^{12}C(\gamma,n)^{11}C$ reaction. (auth)

21329 INVESTIGATION OF γ RADIATION FROM CAPTURE OF THERMAL NEUTRONS IN ^{77}Se WITH THE SUM-COINCIDENCE METHOD. Otto Zehender and Rudolf Fleischmann (Universität, Erlangen, Ger.). Z. Physik, 178: 173-82(1964). (In German)

Two-step cascades of neutron capture γ rays of $^{77}Se(n,\gamma)^{78}Se$ were studied. The employed sum-coincidence method restricts the involved levels facilitating the analysis of the observed spectra. Some new cascades were found and the relative intensities were determined. (auth)

21330 ON THE CONNECTION OF THE INDEPENDENT-PAIR MODEL WITH A VARIATIONAL PRINCIPLE. Klaus Dietrich (Univ. of California, Berkeley). Z. Physik, 178: 335-41(1964). (UCRL-11123)

It is shown that Brenig's method of deriving the basic equations of the Independent-Pair Model can also be understood from a variational principle applied to the pseudo-expectation value $\langle \Pi | H | \Psi \rangle$ (Π = model wave function, Ψ = true wave function). Deviations from a vanishing first and second variation of $\langle \Pi | H | \Psi \rangle$ with respect to the model wave function Π are shown to be due only to the independent-pair approximation, and thus permit a qualitative estimate of the accuracy of the method to be made. (auth)

21331 ON THE INFLUENCE OF THE SHELL STRUCTURE OF THE NUCLEUS ON THE SPECTRA OF μ-MESIC ATOMS. H. Marschall and F. Scheck (Universität, Freiburg i. B.). Z. Physik, 178: 413-17(1964). (In German)

The results of studies on the effects of the shell structure of the Tl nucleus on the spectra of the μ-mesic Tl-atom are presented. (P.C.H.)

21332 REGGE POLES AND RESONANCE NUCLEAR REACTIONS. [PART] I. V. S. Popov and E. I. Dolinskii (Moscow State Univ.). Zh. Eksperim. i Teor. Fiz., 46: 970-84(Mar. 1964). (In Russian)

Resonances in low energy nuclear reactions are considered from the standpoint of the Regge pole concept. Formulas for the amplitude of a reaction of the A + x → B + y type are presented which along with the main Breit–Wigner term contain corrections that are a consequence of analyticity of the partial amplitudes $f_\lambda(E)$ in λ (effect of proper asymmetry of the resonance level). The possibility of observing the effect of proper asymmetry in the angular distribution of the reaction products is discussed. The signature of the resonance level is briefly discussed. An attempt is made to extract from the phase shift data on $^{12}C(\alpha,\alpha)^{12}C$ elastic scattering the parts of the trajectories of the three Regge poles responsible for the resonances. (auth)

21333 ON ASYMPTOTIC EQUALITY OF THE DIFFERENTIAL CROSS SECTIONS FOR PARTICLES AND ANTIPARTICLES. N. N. Meiman (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zh. Eksperim. i Teor. Fiz., 46: 1039-47(Mar. 1964). (In Russian)

The asymptotic value of the ratio of the cross sections $d\sigma_+/dt$ to $d\sigma_-/dt$ for scattering of high energy particles and antiparticles on a given target and prescribed transferred momentum t is investigated. Necessary and sufficient conditions are presented for the ratio tending to unity, to a finite limit differing from unity or to infinity or zero. The special role played by the distribution of zeros of the scattering amplitude A(s,u,t) in the plane of the invariant variable s is elucidated. (auth)

21334 EFFECT OF QUANTUM ABSORPTION ON BREMSSTRAHLUNG OF ULTRARELATIVISTIC ELECTRONS. V. M. Galitskii and V. V. Yakimets (Inst. of Nuclear Physics, Academy of Sciences, Siberian SSR). Zh. Eksperim. i Teor. Fiz., 46: 1066-73(Mar. 1964). (In Russian)

A general method is developed for taking into account the effect of the medium on energy losses of fast particles traversing matter. The method is employed for solving the problem of the effect of absorption on bremsstrahlung of ultrarelativistic electrons. It is shown that at high energies the effect results in strong inhibition of bremsstrahlung in a certain frequency range. In lead, for example, inhibition occurs for $E \gg 10^{14}$ ev in the frequency range 10^8 ev $\ll \omega \ll 10^{-20} E^2$ ev. Density effects are taken into account in the differential electron energy losses due to electron pair production. (auth)

21335 SELF-DIFFUSION IN SINGLE-CRYSTAL TUNGSTEN AND DIFFUSION OF RHENIUM TRACER IN SINGLE-CRYSTAL TUNGSTEN. Robert L'Etrenne Ande-

lin. Thesis, Albuquerque, N. Mex., Univ. of New Mexico, 1963. 155p.

Self-diffusion in single-crystal W and diffusion of Re tracer in single-crystal W were measured over the temperature range 2660 to 3230°C by the direct sectioning technique. The initial radioactive layers of W and Re tracers were produced on the diffusion samples by bombardment with 9.0-Mev deuterons. The tracers observed in determining the diffusion coefficients were ^{185}W, ^{183}Re, and ^{184}Re. Sample preparation and experimental techniques are described. The temperature dependence of the diffusion coefficients in the 2 systems was obtained by least-squares analysis. The results are consistent with a ring mechanism as the fundamental step in W self-diffusion. It is reasonable to conjecture that Re tracer may diffuse through a W lattice by a similar mechanism. Total cross sections as a function of deuteron energy were measured for the reactions, $^{184}W(d,p)^{185}W$, $^{186}W(d,p)^{187}W$, and $^{184}W(d,2n)$ 34-day ^{184}Re by the stacked-foil technique. Cross-section values for the reactions leading to the production of both ^{185}W and ^{187}W increased from about 3 mb at 6 Mev to a fairly broad maximum of 300 mb between 11 and 13 Mev. Cross sections for production of 34-day ^{184}Re range from about 3 to 380 mb for deuterons with energies ranging from 7 to 14 Mev. The decay of ^{185}W was observed over a period of about 9 half-lives, and a new half-life value of 75.14 ± 0.63 days, with the uncertainty expressed to 3 σ, was obtained. The half-life value obtained for ^{187}W was 23.72 ± 0.06 hours. (Dissertation Abstr., 24: No. 8, Feb. (1964))

21336 STATES IN O^{15} AND N^{14} FROM REACTIONS INDUCED BY He^3 ON C^{12} AND PROTONS ON N^{14}, AND N^{13} AND C^{13} FROM $B^{10}(He^3,p\gamma_{15.1})C^{12*}$ AND $B^{11}(d,n\gamma_{15.1})C^{12*}$. Hsin-Min Kuan. Thesis, Houston, Tex., Rice Univ., 1963. 133p.

The total yields of $^{14}N(p,n)^{14}O$ from threshold, 6.345 ± 0.015, to 12 Mev and of $^{12}C(^3He,n)^{14}O$ from threshold, 1.445 ± 0.010, to 3.5 Mev were obtained by measuring the activation of ^{14}O. The differential cross sections at several angles and some angular distributions of the following outgoing radiations induced by ^3He on ^{12}C from 1.8 to 5.4 Mev were also measured: elastic ^3He, α_0, α_1, proton groups corresponding to the formation of the ^{14}N ground state and excited states at 2.311, 3.945, 4.91, 5.10, 5.69, 5.83, 6.23, 6.44, and 7.03 Mev (p_0, p_1, p_2, p_3, p_4, p_5, p_6, p_8, p_9, and p_{11}), and the 6.44 Mev gamma ray ($\gamma_{6.44}$) following the p_9 group. Both the p_9 and the corresponding $\gamma_{6.44}$ show a strong isolated resonance at 2.990 ± 0.010 Mev with Γ_{lab} = 125 ± 10 kev. Analyses, assuming pure compound nucleus formation as the reaction mechanism, on the elastic ^3He, p_9, $\gamma_{6.44}$, p_1, and n_0 data yielded $J^\pi = 5/2^+$ for the 14.46 Mev state of ^{15}O and even parity for the 6.44 Mev state of ^{14}N. Indications of states in ^{15}O at 14.03, 14.27, 14.69, 14.95, 15.43, 15.57, 15.75, 16.07, and 16.48 Mev were also observed. The 15.1 Mev gamma excitation curves of the reactions $^{10}B(^3He,p\gamma_{15.1})^{12*}C$ and $^{11}B(d,n\gamma_{15.1})^{12*}C$(15.1 Mev state, T = 1) were measured. In the reaction $^{10}B(^3He,p\gamma_{15.1})^{12*}C$, there were indications of resonances at $E_{^3He}$ = 2.85 Mev (Γ = 450 kev) and 5.2 Mev (Γ = 240 kev), corresponding to states in ^{13}N at 23.8 and 25.6 Mev. In $^{11}B(d,n\gamma_{15.1})^{12*}C$, there were indications of resonances at E_d = 2.18 Mev (Γ = 140 kev), 3.08 Mev (Γ = 185 kev), 3.71 Mev (Γ = 170 kev), and 4.41 Mev (broad), corresponding to states in ^{13}C at 20.52, 21.28, 21.81 and 22.41 Mev. (Dissertation Abstr., 24: No. 9, March 1964)

21337 ON THE TWO-BODY FORMULATION OF HIGH-ENERGY NUCLEAR SCATTERING PROBLEMS. Kenneth Lawrence Kowalski. Thesis, Providence, Brown Univ., 1963. 284p.

Attention is given to several formal and practical problems directly or indirectly related to the theoretical description of the scattering of high-energy particles, and in particular, nucleons, from complex nuclei. The underlying physical viewpoint of the theoretical description is to picture such scatterings as occurring through the successive interaction of the incident particle with each of the target nucleons. Then, via the so-called impulse approximation (I.A.), the scattering may be approximated by a series of two-body processes. An entirely new and complete theory of the integral equations satisfied by the partial-wave amplitudes of the scattering operators appropriate to, say, a two-nucleon system is presented. The essential feature of the theory is the recognition of the fact that the integral equations are singular or quasi-singular in nature. A reduction of the (quasi-) singular equations to Fredholm forms is carried out. The Fredholm forms admit approximation procedures and a physical interpretation that seems to be distinctly superior to all customary techniques. Integral equations satisfied by the scattering operators in the case when the interaction contains a hard core are derived. The integral equations are cast into a form identical to the case when no hard core is present. Thus, the Fredholm formalism applies equally well whether or not a hard core is contained in the interaction. An extensive discussion is given of the I.A. This approximation is considered in the context of the formulation of multiple-scattering theories, and a prescription is found for its application. Three new multiple-scattering theories were developed in order to study various aspects of the I.A. It was found that one of the customary methods of applying the I.A. seems to lead to inconsistencies and, in addition, is definitely cumbersome in the description of multiple scatterings; numerical calculations are performed that support the contention that this particular form of the I.A. is inconsistent. A derivation of the optical-model formalism, rigorously valid for arbitrary nuclei, was found. This formalism is used to evaluate the contributions due to the excited target states during intermediate multiple scatterings of a particle that is elastically scattered by a nucleus in its ground state. The principal usefulness of this formalism is in the case of very light nuclei where the customary optical-model formalisms are either invalid or inconvenient. With suitable approximations, the customary formalisms can be derived from the present formalism. A method is presented for solving the multiple-scattering equations in the case when the nucleus remains in its ground state during all intermediate multiple scatterings. The method is similar in spirit to the methods used for the partial-wave amplitudes of the scattering operators. Finally, an evaluation was made of the nuclear matrix elements of the two-nucleon scattering operators for the case of a deuteron target. This calculation differs from those previously executed in that the dominant effects of the internal motion of the nuclear particles is taken into account. The results of this calculation are used, in the single-scattering approximation, to compute the cross section and polarization for the elastic scattering of a nucleon by a deuteron. An improved agreement with experiment was obtained. (Dissertation Abstr., 24: No. 9, March 1964)

21338 LEVEL STRUCTURE OF THE SCANDIUM-41 NUCLEUS. Nicholas Albert Brown. Thesis, Houston, Tex., Rice Univ., 1963. 118p.

Differential cross sections for elastic scattering of protons by ^{40}Ca were measured at center-of-mass scattering angles of 91.4, 126.2, and 150.7° for bombarding energies of 1.50 to 6.76 Mev, corresponding to excitation energies in ^{41}Sc of 2.54 to 7.67 Mev. The data were taken in energy steps of approximately 1 kev, and the targets ranged in thickness from 1 to 3 kev. In addition, angular distributions were measured at 15 energies where the cross sections vary slowly with energy. From the data, it was possible to make assignments of resonance energies, widths, and orbital angular momenta for 40 nuclear states below 5 Mev. Above 5 Mev, another 59 resonances were identified, and widths and orbital angular momenta were estimated. Reduced widths were calculated for all of the levels identified, and these were used in the analysis and interpretation of the data in terms of a Lane, Thomas and Wagner type of shell model. The failure of dispersion theory calculations to accurately represent the non-resonant regions of the cross sections led to the hypothesis that major contributions from single-particle shell-model states located outside the region studied are required. This was apparently verified by calculations that remove the discrepancies in the non-resonant cross sections and greatly improve fits to angular distributions. The locations of $2d_{\frac{3}{2}}$, $1f_{\frac{7}{2}}$, and $3s_{\frac{1}{2}}$ single-particle states inferred from these calculations are 7.7, 7.5, and 9.5 Mev, respectively. The reduced width of the known $2p_{\frac{3}{2}}$ state at 1.71 Mev is required to be on the order of 40 per cent of the Wigner limit to produce the best fits to angular distributions. The major contribution to the $2p_{\frac{1}{2}}$ shell was measured at 3.46 Mev and found to have a reduced width of 32 per cent of the Wigner limit. Preliminary correspondences were drawn between the levels observed and known levels in the mirror nucleus ^{41}Ca. Below 4.3 Mev excitation, 18 resonances were located corresponding to 25 levels known in ^{41}Ca. No levels were found in ^{41}Sc for which a reasonable match cannot be found in ^{41}Ca. (Dissertation Abstr., 24: No. 9, March 1964)

21339 METHOD FOR THE MEASUREMENT OF THE LONGITUDINAL POLARIZATION OF ELECTRONS AND A NUCLEAR LEVEL STUDY OF Sc^{44}. James Karl Kliwer. Thesis, Boulder, Colo., Univ. of Colorado, 1963. 156p.

A method for measuring the longitudinal polarization of electrons is described that employs a solenoid beta spectrometer for the collection of Møller scattered electrons. Since the differential cross section for Møller scattering is spin-dependent, the longitudinal polarization of a beam of electrons can be detected by reversing the spin direction of the target electrons in a scattering foil, and observing the asymmetry in the Møller scattered counting rates, which are identified using coincidence techniques. A theory based upon the trajectories of the Møller scattered electrons and the Rutherford scattered electrons was developed, and a predicted Møller counting rate and ratio between the Møller and accidental counting rates were computed. Preliminary experimental results were obtained and these were compared with the theoretical predictions. The experimental Møller rate was found to be about 50 times smaller than the predicted value, which results in a large decrease in the experimental ratio between the Møller and accidental counting rates with respect to the predicted ratio. In spite of the large differences, the asymmetries of -0.072 ± 0.005 and -0.062 ± 0.003, measured for the electrons emitted from ^{144}Pr and ^{90}Y, were encouraging in view of the short time intervals that were available for the collection of data. Aspects of the method are discussed that could explain the differences between the experimental results and the theoretical predictions. In a separate experiment the nuclear level structure of $^{44}_{21}Sc_{23}$ was studied using scintillation and proportional counter techniques in conjunction with a measurement of the directional correlation function for the two cascade gamma rays, which were found to follow the electron capture decay of ^{44}Ti. In particular, the electron capture transition was found to populate the second excited state of ^{44}Sc, which subsequently de-excites by the emission of two gamma rays of energies 77.8 ± 0.5 and 67.5 ± 0.5 kev. The 78-kev transition was found to precede the 68-kev transition and the half life of the intermediate state was measured to be 166 ± 5 nsec. A limit of 1% was set for the 146-kev crossover transition relative to the 68- and 78-kev transitions. Further information concerning these levels was obtained by studying the decay of the 6^+ ^{44m}Sc state. No transitions to either the first or second excited states were detected and limits of 1% and 0.06% were set for these transitions, respectively. A proportional counter was constructed that completely resolved the two gamma rays and the ratio of their intensities was found to be $I_\gamma(68\,\text{kev})/I_\gamma(78\,\text{kev}) = 0.85 \pm 0.20$. This ratio and the measurement of the directional correlation function, which was $A_2 = 0.076 \pm 0.007$, resulted in an assignment of $I = 2^+$ and $I = 1^+$ for the first and second excited states. (Dissertation abstr., 24: No. 9, March 1964)

21340 SCATTERING OF 15.2 Mev NEUTRONS BY COMPLEX NUCLEI. William Scott Walker. Thesis, Charlottesville, Va., Univ. of Virginia, 1961. 93p.

A need for additional data on neutrons elastically scattered by deformed heavy nuclei prompted a measurement of the elastic angular distributions of 15.2 Mev d-t neutrons on tantalum, thorium, and uranium. The associated particle technique was used with a time-to-pulse-height converter to measure the time of flight of neutrons over a distance of 179 cm. The percent energy resolution at 15.2 Mev was 16%. The neutron detector was a 13 cm diameter by 15 cm long plastic scintillator. Cylindrical scatterers were used, and the angular distributions were taken from 10 to 162° in 2 to 10° intervals. For comparison with a spherical nucleus, the angular distribution for Bismuth was also measured. The data were corrected for multiple scattering through the first minima of the angular distributions by an analytical method. Data were obtained for several thicknesses of Ta and Bi in order to check the multiple scattering correction. The results were compared with the spin-orbit spherical optical potential calculations computed by Bjorklund and Fernbach for the four elements at 15.2 Mev. The experimental Ta cross section is slightly smoothed out compared to the theoretical cross section, but the large discrepancies known to exist at 7 Mev for Ta were not found. The conclusion is that the deformation effect is not as large at 15.2 Mev. The Th and U cross sections are nearly identical, as expected from the nearness of their atomic weights. The measurements for Th and U do not show the very deep first minima predicted by the spherical potential. This discrepancy may be the effect of contributions to the measured cross section from the low-lying states. Also, Th and U are outside of the range of atomic weights used to set the optical model parameters, and the discrepancies may reflect this rather than a deformation effect. The experimental and theoretical cross sections for Bi are in good agreement. (Dissertation abstr., 24: No. 9, March 1964)

21341 HILBERTSCHE RÄUME MIT KERNFUNKTION. (Hilbert Space with Nuclear Functions). Herbert Meschkowski. Berlin, Springer-Verlag, 1962. 263p. DM 53, --.

General characteristics of the Hilbert space, the reproducing nucleus, examples of Hilbert space with reproducing nucleus, the Hilbert-space positive matrices, orthonormal systems with special properties, normal diagrams, the presentation of functions, problems of extremes, double orthogonality, Hilbert space from solution of elliptical differential equations, and nuclear functions in the theory of functions of more complex variability are discussed. (M.C.G.)

21342 ON MOMENTUM EXCHANGE IN ELASTIC SCATTERING—NEUTRAL PARTICLES AND PERFECT CRYSTAL. Earl Beder. Thesis, Los Angeles, Calif., Univ. of Southern California, 1963. 238p.

Quantum and classical microscopic theories were developed for macroscopic forces on a solid surface resulting from elastic collisions with a uniform beam of neutral, noninteracting, mass-point particles. The solid is a perfect dielectric crystal of period d. The gas-solid interaction potential energy is the weak van der Waals one of physical adsorption normal to the wall (z axis), with a small sinusoidal perturbation along the wall (x axis). Without a periodic perturbation, specular reflection occurs. This theory is of interest in low-temperature gas-dynamics. Appropriately for a study, primarily conceptual rather than quantitative, a two-dimensional semi-infinite crystal and square-well interaction potential were assumed. The square-well potential distinguishes three z regions: the solid with infinite potential, the surface square-well layer with negative periodic potential and thickness comparable to d, and the zero potential region beyond. Quantum-mechanical forces follow from energy eigenfunctions $\psi(E,\theta_i,x,z)$ for an incident plane wave representing a uniform beam of particles. (θ_i = incidence angle from negative x axis; $0° \leq \theta_i \leq 90°$). Particle energy eigenvalues E are positive and continuous and eigenstates are free only. Particle density $\psi^*\psi$ is periodic as the crystal. ψ is identically zero in the solid and is a series of exponential functions in the zero potential region. In the surface layer it is a series containing Mathieu functions of period π or 2π or of nonintegral order, depending upon incidence angle. The scattered beam consists of a finite number of plane waves with varying particle density. As in classical kinetic theory, forces on the crystal were determined from fluxes of momentum through x and z surfaces of a control volume. These fluxes require the simultaneous specification of the x or z position of a particle, and the x and/or z component of momentum. In all cases two observables are conjugate and subject to uncertainty principle limits. With the help of approximate expansions of ψ in momentum eigenfunctions, valid for distinguished spatial regions, the fluxes and forces were determined. General results from the theory are discussed. The much simpler classical theory agrees with the quantum-mechanical one above the domain of strong diffraction and disagrees increasingly below. Classical theory may not be used to find the extrema of forces. (Dissertation abstr., 24: No. 9, March 1964)

21343 STUDIES OF U^{235} FISSION IN COINCIDENCE WITH PROMPT FISSION γ-RAYS. Edward Lee Cooperman. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 105p.

The fission fragments from thermal fission of ^{235}U were investigated with regard to their kinetic-energy distribution, mass distribution, mass ratio, and angular distribution. A modified Frisch gridded double ionization chamber was used, which contained a thin foil of plastic upon which ^{235}U was deposited. The gas in the chamber consisted of ~93% A + 7% CO_2 operating at slightly under atmospheric pressure and at saturation voltage. A 3" × 3" NaI(Tl) crystal was used as the γ detector. The electron pulses produced by the fission fragments were collected at the anode in ~.2 μsec, and a coincidence circuit was set up between this pulse and the prompt fission γ ray. The positive ion pulses were collected at their respective anodes in the order of a few msec, the time of collection depending upon the angle of emission of the fragments as well as the length of the ionization path produced. Thus, the energy, mass, and angle of emission of the fragments could be obtained in coincidence with different prompt γ radiation. An automatic recording circuit recorded the data, which was analyzed by an IBM 7074. Tests were run for γ radiation >2 Mev and γ > 3 Mev, and the results compared to all γ's (i.e., the standard double-humped energy curve). Pronounced structural effects increasing with γ energy were noticed in both the fission fragment kinetic energy and the mass ratio distribution. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21344 A DETAILED INVESTIGATION OF THE TENSOR FORCE AND THE PAULI EXCLUSION PRINCIPLE IN NUCLEAR MATTER. Ernest John Irwin, Jr. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 134p.

The nature of the nuclear two-body tensor force is discussed, and various methods of solving the states affected by the angular-momentum coupling of this force are explored. The methods studied are a modified Born approximation (separation of potential at core radius), modified Moszkowski-Scott separation, and the reference spectrum with no potential separation. An equivalent central force is found that may exactly replace the tensor force, and there is confidence that the usual central-force methods for dealing with the nuclear matter problem apply in these tensor states. The effects of the Pauli exclusion principle and changes in the single-particle energy spectrum are explained. The effect of the Pauli exclusion principle is examined in detail. Two features are treated separately: the intermediate available volume is reduced, and is dependent on the center-of-mass momentum of the interacting particle-pair; and the asymmetry of the Fermi surface for nonzero center-of-mass momentum causes angular momentum mixing. The latter feature is explained in full detail and calculated. The net result is very small and contributes the order of 0.1 Mev per particle to the single-particle energies. The former feature is important, and methods required for proper treatment are given. The tensor states are treated using a separable potential, which has some unusually nice properties and illustrates well the salient features of the tensor force. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21345 NUCLEON-NUCLEON INTERACTIONS INSIDE LIGHT NUCLEI. John Frederick Dawson. Thesis, Stanford, Calif., Stanford Univ., 1963. 143p.

Free nucleon-nucleon interactions are used to compute level structures of light nuclei. The basic idea involves the observation that the two-particle harmonic oscillator Hamiltonian, containing a general interaction term, can be separated into center-of-mass and relative terms and, therefore, solved exactly. However, the presence of other particles makes such a separation incompatible with the Pauli principle. Therefore, a method is developed to compute excitation spectra of doubly magic plus two-nucleon nuclei along the lines of the Bethe-Goldstone theory for infinite nuclear matter, using harmonic oscillator unperturbed wave functions. The interaction is diagonalized among the degenerate states, and the matrix elements are related to integrals over Bethe-Goldstone wave functions

in the relative coordinate system. These wave functions are computed by solving the relative Schrödinger equation numerically and then corrected for the many-body Pauli principle effect. The method is applied to ^{18}O, ^{6}He, and ^{6}Li using the Brueckner-Gammel-Thaler and Hamada potentials, which contain hard cores, and various nonsingular potentials, which fit the low energy nucleon-nucleon scattering data. No adjustable parameters are used. The results indicate that the experimentally observed excitation spectra of these nuclei, as well as a number of other observables, can be well accounted for by the free nucleon-nucleon interactions. The hard-core potentials give essentially the same results as the simpler nonsingular potentials for the A = 6 isobars; however, the ^{18}O level structure is more sensitive to details of the interaction. It is hoped that by including corrections to the theory, one might be able to pin down the exact form of the nucleon-nucleon interaction inside these nuclei. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21346 GROUND STATE PROPERTIES OF THE Ca^{40} NUCLEUS. Kenneth Leroy Hartt. Thesis, Lincoln, Neb., Univ. of Nebraska, 1963. 80p.

Ground-state properties of the ^{40}Ca nucleus are computed using a formulation of Brillouin-Wigner perturbation theory, which has had success in relating an assumed interaction to the properties of light nuclei. The second-order effect of the tensor interaction on the energy and configuration mixing to the shell model state, ϕ_0, are determined. The photonuclear dipole absorption cross sections, σ_{int} and σ_b, are also computed in zeroth order. A formula for σ_b is derived and discussed. The wave function is found to contain a 30% admixture to the shell model state. The second-order energy minimizes at −495 Mev, compared with the experimental value of −342 Mev; the tensor contribution is −112 Mev. The zeroth-order rms radius, R_{rms}, is 2.24 fm (1 fm = 10^{-13} cm), as contrasted with the published value, adjusted for finite proton size, of 3.43 fm. A Born approximation analysis of high-energy electron scattering data using an oscillator charge distribution allows a lower limit for R_{rms} of 3.10 fm. An explanation of the discrepancy between experiment and our theoretical R_{rms} is advanced. The value computed for σ_{int} is 788 Mev-mb, which is 31% higher than what is given by the TRK sum-rule. The exclusion principle in effect lowers σ_b to a value of 24.5 mb. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21347 DETERMINATION OF THE SHAPE OF THE SPECTRUM OF ORBITAL ELECTRONS EJECTED ACCOMPANYING THE ELECTRON-CAPTURE DECAY OF Fe^{55}. James Gordon Pengra. Thesis, Corvallis, Ore., Oregon State Univ., 1963. 71p.

The energy spectrum of electrons ejected in the decay of ^{55}Fe was measured from 30 kev to the vicinity of the end point at 218 kev. The electrons from a thin, aged source mounted on a 50-$\mu g/cm^2$ Formvar backing were detected in a proportional counter or, alternatively, in a solid state detector, in coincidence with Mn K x rays recorded by a NaI(Tl) scintillation crystal. The experimental data were corrected for wall effect in the proportional counter, inner bremsstrahlung, chance coincidences, and background. An energy correction was applied to account for summing of x rays and Auger electrons with ejected electrons in the counters. Electron backscattering from the source and the source backing was considered. The experimental results indicate that the ejected-electron spectrum falls off more slowly with energy than predicted by the theory for ejection of K-shell electrons, particularly in the 30- to 80-kev region. Contributions to the spectrum by L-shell electrons ejected accompanying K capture were calculated and found to contribute less than 0.1% over the energy range considered. L capture is not expected to affect the spectral shape. To bring the theory into accord with experimental results, it may be necessary to modify the assumed initial-state wave function for a 1s electron in a many-electron atom. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21348 RADIOACTIVE DECAY OF Tb^{151} AND Tb^{152}. Harry Galen Miller. Thesis, Columbus, Ohio, Ohio State Univ., 1963. 66p.

The γ rays from the radioactive isotopes produced by a 17-Mev ^{3}He bombardment of 97.8% enriched ^{151}Eu were investigated. Comparison spectra were obtained experimentally by bombarding the same isotope with 22-Mev α particles and 6-Mev protons. Also 81.0% ^{150}Sm, 21.8% ^{152}Gd, and 94.85% ^{153}Eu were bombarded with 6-Mev protons. Comparison of the spectra and consideration of the coincidence data indicated that the isotopes ^{151}Tb and ^{152}Tb, both with an 18-hr half life, were produced in the ^{3}He bombardment. Further study of the relative intensities of the γ rays and of the coincidence data led to the construction of energy level diagrams for these isotopes. The well-known activities of ^{153}Tb, ^{154}Tb, and ^{150}Eu with comparable half lives were also produced and verified as well as the longer lived isotopes of ^{151}Gd and ^{153}Gd. An exact calculation to determine the relative intensities of the γ rays was made to replace a previous approximation. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21349 A STUDY IN SIMPLE MODELS FOR THE Be^{9} NUCLEUS. Glen Underhill. Thesis, Lincoln, Neb., Univ. of Nebraska, 1963. 121p.

A two-body model of the ^{9}Be nucleus is discussed, in which the nuclear reaction properties are attributed largely to the unpaired or "valence" neutron. The polarizability and E 1(γ,n) cross sections are worked out analytically for a p neutron orbiting about a structureless 8-nucleon core and are compared with available experimental information. The momentum distribution of the neutron, the rms radius of its orbit, the coulomb energy difference from the mirror nucleus, and the spin-orbit splitting are discussed as criteria, which the ground state must satisfy. The use of plane-wave s states is found to be unsatisfactory, because they do not account for the sharply peaked behavior of the observed (γ,n) cross sections. Square-well potentials were found to give reasonable results for the low-energy (γ,n) cross sections and the polarizability, as well as for the ground state properties. Adding a linear taper to the well provided some improvement in the predicted (γ,n) cross sections. The Saxon potential with spin-orbit force is investigated, and the resulting calculations are compared with those of Francis, Goldman, and Guth. The advantages of this potential over the square well appear to be overrated. The rotational model and α-particle model are discussed and found capable of explaining additional features of the nucleus. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21350 COULOMB EXCITATION OF SOME RADIOACTIVE NUCLEI. Jesse Clifton Albergotti, Jr. Thesis, Chapel Hill, N. C., Univ. of North Carolina, 1963. 80p.

The method of Coulomb excitation was used to study the low-lying nuclear-energy-level structure in several radioactive nuclei. Protons from a 2-Mev Van de Graaff were used to bombard isotopes of ^{147}Pm, ^{147}Sm, and ^{99}Tc. De-excitation γ rays were observed with a NaI(Tl) scintillation spectrometer. Gamma-ray energies of 120 ± 2.2 kev, 199 ± 3.1 kev for ^{147}Sm, and 140 ± 2.5 kev, 178 ± 2.9 kev for ^{99}Tc

were obtained for the first time by the method of Coulomb excitation, although the energy levels were known to exist previously from β-decay studies. The absolute cross section and partial reduced transition probability were estimated for ^{147}Sm and ^{99}Tc. The presence of ^{147}Sm as an impurity in the ^{147}Pm sample prevented an accurate measurement of its γ-ray spectrum. Total reduced transition probabilities were in accord with the single-particle estimate. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21351 DIRECTIONAL CORRELATION AND POLARIZATION-DIRECTION CORRELATION OF GAMMA RAYS IN As^{77}. Michel Bernard Martin. Thesis, Ann Arbor, Mich., Univ. of Michigan, 1963. 97p.

A method for the graphical analysis of the polarization-direction correlation experiments was derived. It completes an existing method for the graphical analysis of directional correlation experiments. A polarization-sensitive detector, based on the fact that the Compton cross section depends on the polarization direction of the incident γ ray, was built and calibrated. The γ-γ direction correlations of the 210 kev–265 kev, 367 kev–265 kev, 417 kev–215 kev, 563 kev–632 kev, 563 kev–417 kev, and 563 kev–367 kev cascades in ^{77}As were measured. The γ-γ polarization-direction correlations of the 417 kev transition in the 417 kev–215 kev cascade, and of both transitions in the 367 kev–265 kev, 210 kev–265 kev, and 563 kev–632 kev cascades were measured. The results were found to be consistent with the spins of $^3/_2^-$, $^3/_2^-$, $^5/_2^-$, $^9/_2^+$, and $^5/_2^+$ for the ground, 215 kev, 265 kev, 475 kev, and 632 kev levels. A spin of $^7/_2$ for the 1.19 Mev level was found to be consistent with experimental results. The ranges of the quadrupole content Q or octupole content O of the radiations are presented. It is shown that the level structure of ^{77}As cannot be explained in a simple way by either the unified model or the pairing model of the nucleus. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21352 GAMMA RADIATIONS FROM EXCITED STATES OF N^{18}, O^{19}, AND Ne^{19}. Wyatt Wendell Givens. Thesis, Houston, Tex., Rice Univ., 1963. 164p.

A magnetic-lens spectrometer was used to study the low-energy γ rays and internal conversion electrons emitted from excited states in ^{18}N, ^{19}O, and ^{19}Ne. ^{18}N was produced in the reaction ^{15}N(d,p)^{18}N. The photoelectron spectra using Cd and Au radiators suggest low-energy γ rays from excited states in ^{18}N having energies of 397.3 ± 1.0, 296.2 ± 1.0, 275.9 ± 1.0, 120.1 ± 0.5, and 100 ± 3 kev. The "external-internal" conversion method was used to measure the K internal-conversion coefficient for the 120 kev transition in ^{18}N. The value $\alpha_k = (7.23 \pm 1.42) \times 10^{-3}$ for the 120 kev transition indicates an E2 transition, which is consistent with the present spin and parity assignments. The γ-ray branching for individual levels in ^{18}N was also measured. ^{19}O was produced in the reaction ^{18}O(d,p)^{19}O. The energy of the first-excited level in ^{19}O was determined from both the internal conversion and photoelectron spectra to be 95 ± 2 kev. The K internal-conversion coefficient for the 95 kev first-excited to ground state transition in ^{19}O was measured to be $(6.27 \pm 1.13) \times 10^{-4}$. This value implies M1 radiation. Therefore the possibility of the first-excited level of ^{19}O having negative parity was eliminated. ^{19}Ne was produced in the reaction ^{19}F(p,n)^{19}Ne. Relative intensity measurements of the internal conversion electrons and, separately, of the γ rays emitted from the first two excited states in ^{19}Ne confirm the fact that the first-excited 241 kev level in ^{19}Ne has a higher angular momentum than the second-excited 271 kev level. Therefore, the spins of the first two excited states are reversed in the mirror nuclei ^{19}Ne and ^{19}F. The energy of the first-excited level in ^{19}Ne was measured to be 241 ± 4 kev, and the energy of the second-excited level was measured to be 271 ± 4 kev, which is about 10 kev lower than the energy indicated by neutron threshold methods. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21353 NUCLEAR THEORY REFERENCE BOOK FOR 1961 AND 1962. Compilation of Nuclear Theory Index Cards. R. Nakasima and H. Ogata (National Academy of Sciences and National Research Council). Dec. 1963. 173p. $1.25(GPO).

References (1518) to theoretical papers on nuclear structure, nuclear reactions, electromagnetic radiation, beta decay and parity, alpha decay, and other topics are compiled. The papers appeared in journals and reports during 1961 and 1962. An author index is included. (D.C.W.)

21354 ON THE DECAY OF $_{38}Sr^{83}$. K. R. Reddy, A. S. Johnston, and S. Jha (Carnegie Inst. of Tech., Pittsburgh). 10p. (CONF-481-30)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The decay scheme and gamma spectra of ^{83}Sr are presented. (C.E.S.)

21355 ON THE DECAY OF 66 MIN In^{110}. T. D. Nainan, A. S. Johnston, and S. Jha (Carnegie Inst. of Tech., Pittsburgh). 11p. (CONF-481-29)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The decay scheme and gamma spectra of ^{110}In are presented. (C.E.S.)

21356 NUCLEAR PAIR-CORRELATION FUNCTION VIA ELECTRON SCATTERING. Yogendra N. Srivastava (Indiana Univ., Bloomington). 65p. (CONF-481-34)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The measurement of the two-nucleon correlation function at very small distances in light or medium nuclei by means of electron inelastic scattering accompanied by the emission of two nucleons is discussed. A computation of the cross section on the basis of an assumed electromagnetic interaction is given. The matrix element for transition is derived on the basis of the quasi-deuteron model. The final state corrections are also discussed. (C.E.S.)

21357 MASS OF Ni^{56}. R. G. Miller, R. W. Kavanagh, and G. Goldring (California Inst. of Tech., Pasadena). 8p. (CONF-417-24)

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

An experiment in which the mass and first two excited states of ^{56}Ni were determined is described. Since ^{56}Ni decays entirely by electron capture an accurate mass estimate from beta-decay data is impossible. The ^{54}Fe(^{3}He,n)^{56}Ni reaction was used, and the ^{60}Ni–^{60}Co mass difference was estimated as being between 2 and 2.3 Mev. (C.E.S.)

21358 ANALYSIS OF NUCLEAR ENERGY LEVELS RESULTING FROM A SELF-CONSISTENT NUCLEAR MODEL. B. F. Rozsnyai (International Business Machines Corp., San Jose, Calif.). 11p. (CONF-481-35)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Self-consistent field calculations for atomic nuclei were applied to ^{208}Pb, ^{140}Ce, ^{90}Zr, and ^{40}Ca. The nucleon energy levels, the binding energy per nucleon, and the nucleon potentials were determined. (C.E.S.)

21359 ELASTIC SCATTERING OF He^3 AT 20 Mev. Raymond W. Klingensmith (Battelle Memorial Inst., Columbus, Ohio), Hershel J. Hausman, and William D. Ploughe. 30p. (CONF-250-19)

From American Physical Society 1963 Summer Meeting in the West, Edmonton, Canada, Aug. 1963.

Absolute differential elastic scattering cross sections were measured for the scattering of 20-Mev ^3He particles from V, Ni, Cu, Rh, ^{118}Sn, Sm, Yb, and Pb. Where practical the measurements were made at laboratory angles extending from 20 to 170 degrees. The diffraction-like oscillations exhibited by the elastic-to-Coulomb cross section ratios are not highly pronounced. A preliminary optical model analysis was carried out using the HUNTER automatic search code of Drisko and Bassel. A Woods-Saxon potential with Thomas type spin-orbit coupling was considered. Reasonable fits to the data were obtained. (auth)

21360 NUCLEAR ORIENTATION AND MAGNETIC MOMENT OF Hg^{199}. William T. Walter (Massachusetts Inst. of Tech., Cambridge). 10p. (CONF-481-1)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Optical pumping enables the application of nuclear magnetic resonance techniques to dilute gases and vapors. Utilization of this method to measure magnetic moments of radioactive nuclei was first demonstrated with ^{197}Hg. Orientation of a second radioactive mercury isotope was achieved. A single quartz cell was filled with both $I = \frac{1}{2}$ isotopes, 9.5-h ^{195}Hg and stable ^{199}Hg. An ^{202}Hg lamp inside the air gap of a Bitter solenoid produced the circularly polarized 2537-Å light that was Zeeman-shifted to pump either isotope. Nuclear magnetic resonance in the oriented vapor of each isotope was optically detected in the scattered light. Resonances, 30–50 c wide, were observed at 726 and 678 kc. The measured ratio $\mu_{195}/\mu_{199} = 1.070356(66)$. Using Cagnac's ^{199}Hg result, $\gamma_{195}/\gamma_H = 0.190813(12)$ and $\mu_{195} = 0.532892(33)$ nm were obtained without diamagnetic correction. Errors quoted are three times the standard deviations. (auth)

21361 THE DECAY OF Xe^{137}. R. J. Onega. 10p. (CONF-481-18)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The decay of ^{137}Xe was investigated by scintillation techniques. A 128-channel analyzer was used for both beta and gamma ray measurements. (auth)

21362 SCATTERING OF 5-15 Mev PROTONS FROM Be^9. F. W. Bingham, M. K. Brussel, and J. D. Steben (Univ. of Illinois, Urbana). 16p. (CONF-481-17)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Cross section angular distributions for elastic and inelastic proton scattering from ^9Be at 5 to 15 Mev are presented. The inelastic cross sections measured are for the formation of the 2.43-Mev excited state. (C.E.S.)

21363 CAPTURE REACTION $K^{39}(p,\gamma)Ca^{40}$ IN THE GIANT RESONANCE REGION. J. C. Hafele, F. W. Bingham, and J. S. Allen (Univ. of Illinois, Urbana). 31p. (CONF-481-21)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The 90° differential cross sections were measured for proton radiative capture in ^{39}K at 6 to 15 Mev. The yield of gamma rays from transitions to the ground state of ^{40}Ca was found to pass through a giant resonance for excitation energies between 18 and 22 Mev, and four more fine structure peaks were found. In addition to gamma rays from transitions to the ground state of ^{40}Ca, a secondary, lower energy spectral line was also found. (C.E.S.)

21364 PHOTONUCLEAR REACTIONS IN A UNIFIED THEORY. W. M. MacDonald (Univ. of Maryland, College Park). 21p. (CONF-481-31)

From American Physical Society Annual Meeting, New York, Jan. 1964.

Photonuclear reactions are treated within the framework of the unified theory. The transition amplitude is the sum of a non-resonant direct transition matrix element and of a resonant compound nuclear term determined by an effective interaction. The difficulties associated with the use of virtual states are discussed and resolved. (auth)

21365 INTERNAL CONVERSION IN Sn^{119}. N. Benczer-Koller (Rutgers Univ., New Brunswick, N. J.). 24p. (CONF-481-26)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The total internal conversion coefficient of the ground state 23.8-kev transition in ^{119}Sn and the ratio $[K/(L + M+\ldots)]_{M4}$ of internal conversion coefficients of the preceding 65.3-kev M4 transition were determined by measuring the coincidence rate between the K x rays following internal conversion of the 65.3-kev transition, and the 23.8-kev gamma rays. The following results were obtained: $\alpha = 5.2 \pm 0.3$ and $[K/(L+M+\ldots)]_{M4} = 0.42 \pm 0.02$. (auth)

21366 SPIN-ORBIT INTERACTIONS IN STRIPPING REACTIONS. M. A. Nagarajan (Case Inst. of Tech., Cleveland). 12p. (CONF-481-23)

From American Physical Society Annual Meeting, New York, Jan. 1964.

The effect of spin-orbit interactions on the angular distribution and polarization in stripping reactions is studied. Only the spin-orbit interaction in the final channel was considered. It is shown that it is necessary to make a first order Born approximation treatment of the spin-dependent distortions in order to obtain simple relation between the polarization and differential cross section. (auth)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 20136, 20137, 20144, 20146, 20602, and 20842.

21367 (AD-429133) LO-TEMP THERMIONIC PLASMA STUDY. Yearly Report. (Ford Instrument Co., Long Island City, N. Y.). Dec. 1963. Contract Nonr-3416(00). 52p.

The low-temperature, impregnated tungsten, cesium diode was extended from its original planar configuration to a cylindrical geometry in higher power ranges. Various cylindrical converters were designed, fabricated, and operated in both steady-state and pulsating modes. A multiple collector device to evaluate and compare different collector materials in the same diode environment was designed and fabricated. (auth)

21368 (AFCRL-63-161) MICROWAVE MEASUREMENTS OF FINITE PLASMAS. RCA Victor Research Report 7-801-26. Scientific Report No. 2. M. P. Bachynski, G. G. Cloutier, and K. A. Graf (RCA Victor Co., Ltd. Research Labs., Montreal). May 1963. Contract AF19 (604)-7334. 182p. (AD-415324)

Investigations are described which were designed to test the validity of various theoretical treatments of plasma properties and to assess the accuracy of various microwave systems for determining the properties of plasmas which are finite in extent using free-space microwave techniques. Theoretical results were obtained for the prediction of plasma effects. Measurements on various experimental geometries demonstrated the influence of the dielectric boundaries of the plasma container, the effect of multiple reflections within the measurement system, and the precautions which must be exercised both in the measurement and interpretation of the results. Measurements of plasma properties using a number of different microwave arrangements are assessed, and the limitations of the various systems are shown. The properties of a plasma generated in He and in Ar were measured using the optimum microwave arrangement. (auth)

21369 (ATN-64(9233)-8) A COMPUTER PROGRAM TO DETERMINE PLASMA DENSITY FROM EXPERIMENTAL HYDROGEN SPECTRAL LINE SHAPES. General Research. D. A. McPherson and H. S. Porjes (Aerospace Corp., El Segundo, Calif.). Mar. 23, 1964. 23p.

The IBM 7090 program fits theoretical hydrogen line shapes to experimental line shapes in order to determine plasma density. The fitting process is discussed to illustrate the limitations of the program. The resolution of the optical system is taken into account. Data input and output are considered in detail, and a specific computation by the program is presented. (auth)

21370 (CEA-R-2410) INJECTION LONGITUDINALE DE PARTICULES CHARGEES DANS UNE CONFIGURATION MAGNETIQUE STATIQUE A MIROIRS. (Longitudinal Injection of Charged Particles into a Static Magnetic Configuration with Mirrors). J. P. Girard and C. Gourdon (European Atomic Energy Community and France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). 1964. 60p. (EUR-544.f)

The theoretical study of the capture of charged particles injected longitudinally into a modulated magnetic configuration of the type proposed by Sinelnikov is extended by the use of the idea of a limited surface. This makes it possible to define the injection conditions which seem to lead to longer confinement times. The injection proposed is effected near a trajectory which is asymptotic to equilibrium trajectory situated in the plane of a mirror. Under these conditions the limiting surface is almost completely closed to the mirrors. The initial magnetic moment is no longer zero, but already has the maximum value compatible with a penetration of the first mirror. A very small increase in the magnetic moment is then sufficient to ensure the capture of the particles; this is easily attained with a very low modulation factor. It is shown that capture can occur without modulation by a simple nonadiabatic effect due to the curvature of the field near the mirrors. The influence on the capture in these conditions of a weak parasitic component of the magnetic field which is perpendicular to the axis of revolution of the main configuration is studied. (auth)

21371 (CLM-R-33) KINETIC THEORY OF THE FLUTE INSTABILITY. Miloš Seidl (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Oct. 1963. 30p.

A recursive procedure is presented which is suitable for solving the Vlasov equation for systems having a simple unperturbed Hamiltonian function. The method is used to investigate the stability of a low-beta plasma supported against gravity by a magnetic field. The effect of finite plasma boundary layer thickness and of an electric field is investigated to zero order in Larmor radius. The suitability of the gravitational model for investigating the flute instability in a mirror machine is discussed. It is shown that, if the energy dependence of the drift velocities in the mirror machine is taken into account, the stability condition is much different, even to the lowest order in Larmor radius, from that in a simple gravitational model. (auth)

21372 (CLM-R-34) TRACING OF OBLIQUE RAYS IN PLASMA CYLINDERS. M. A. Heald (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Abingdon, Berks, England). Feb. 1964. 30p.

The trajectory of an oblique ray in an axially symmetric inhomogeneous medium is formulated in the geometrical optics approximation. The attenuation due to electron-ion collisions and the angular deflection of a microwave ray traversing a cylindrical plasma column are evaluated, together with the statistical averages of these quantities over impact parameter and obliquity angle. The results of numerical computations for several simple electron-density profiles are shown graphically. (auth)

21373 (EUR-495.i) ESPERIENZE SULLE GUAINE DI CARICA SPAZIALE. (Experiments on Space Charge Sheaths). Franca Magistrelli (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). 1964. 14p. (CONF-468-1)

From Conference on Some Aspects of the Physics of Plasma, Milan, May 1963.

The experimental program is summarized. An experiment on sheath formation in a weak azimuthal magnetic field led to studies of the current limitation in a low-pressure mercury arc and of the stationary plasma. Work preliminary to a study of ionic waves in low-pressure mercury arcs and cesium plasmas in thermodynamic equilibrium is reported. The appartus for these experiments will also be used to study plasma in equilibrium. Experiments on the unipolar arc, r-f plasmoids, and a method for obtaining a high d-c current in gases other than mercury are briefly described. (auth)

21374 (GNE/PHYS/63-2) AN EXPERIMENTAL AND THEORETICAL STUDY OF THE WALL-STABILIZED, TRANSPIRATION-COOLED DC ELECTRIC ARC (thesis). Michael F. Baran (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1963. 120p. (AD-419023)

A wall-stabilized, transpiration-cooled arc device was built which consisted of a cathode chamber containing a 0.25-in. diameter W cathode, 12 half-inch thick wall segments containing porous graphite segments through which Ar at about 1.1 atm was injected into the 0.25-in. diameter arc channel, and a hollow, cylindrical water-cooled Cu anode which served as the plasma exhaust. Cooling water to the cathode, the wall sections, and the anode provided information on the power losses to the device components. The Ar flows to the cathode chamber and each wall segment were individually controlled and monitored by specially built coiled capillary flowmeters. The device proved extremely stable, and after 30 hours of operation, electrode wear was not detectable. For arc powers in the range of 8 to 20 kw (dc), and mass flows on the order of 22 to 29 lb/hr, gas enthalpies from 600 to 1400 Btu/lb were obtained at a device efficiency of 50%. (auth)

21375 (MATT-236) SPECTROSCOPIC INVESTIGATION OF A WEAKLY IONIZED PLASMA IN A HELIUM HOLLOW CATHODE DISCHARGE. Joseph G. Hirschberg, Einar Hinnov, and Fritz W. Hofmann (Princeton Univ., N. J.

Plasma Physics Lab.). Sept. 1963. Contract AT(30-1)-1238. 16p. (CONF-75-8)

From 6th International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963.

The spectrum of a helium cathode discharge tube was studied in the visible and vacuum ultraviolet regions. Doppler temperatures of ion and representative neutral lines were calculated from line profiles measured with a photoelectric Fabry-Perot interferometer. Approximate electron densities and temperatures were determined from the gross features of the observed distribution of excited states. Dominating processes producing some of the details of the neutral helium excitation are proposed. (auth)

21376 (MATT-238) KINETIC THEORY OF WEAKLY COUPLED GASES. C. H. Su, E. A. Frieman, and M. D. Kruskal (Princeton Univ., N. J. Plasma Physics Lab.). Jan. 1964. Contract AT(30-1)-1238. 158p.

Using the multiple-time-scale method on the Bogoliubov-Born-Green-Kirkwood-Yvon hierarchy, the weak coupling expansion is carried out to higher orders. It is found that there are two local breakdowns of the expansion. One occurs at small relative velocities between particles. The correct asymptotic representation for the small relative velocity region is given. The second breakdown occurs for particles having a large separation at time t with their relative velocity oriented in such a way that they were in collision at t = 0. Such a breakdown indicates that, in contrast to the Bogoliubov functional assumption, the higher order correlation functions should vary on the kinetic time scale in their own right. A sufficient condition on the smoothness of the initial correlation functions is given, such that the Fokker-Planck equation is obtained as the lowest order approximation in the expansion. The connection between irreversibility and the requirement of nonsecularity in the multiple-time-scale formulation is also indicated. (auth)

21377 (MATT-247) POWER BALANCE MEASUREMENTS IN THE C-STELLARATOR WITH DIVERTOR. A. S. Bishop, A. Gibson, E. Hinnov, and F. W. Hofmann (Princeton Univ., N. J. Plasma Physics Lab.). Jan. 1964. Contract AT(30-1)-1238. 15p. (CONF-471-2)

From the American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

Impurity radiation and power balance in the stellarator when operated with the divertor and pulsed gas feed were studied. The axial and radial distribution of radiation within the stellarator was obtained to determine the proper correction to intensity measurements made with the ultraviolet monochromator. The power radiated in helium discharges was measured. Notably, the radiated power due to oxygen was negligible. Power balance measurements in helium and hydrogen discharges were also made. (D.C.W.)

21378 (MATT-251) IMPURITY CONCENTRATIONS AND ELECTRON TEMPERATURES IN THE C-STELLARATOR. E. Hinnov, A. S. Bishop, A. Gibson, and F. W. Hofmann (Princeton Univ., N. J. Plasma Physics Lab.). Feb. 1964. Contract AT(30-1)-1238. 13p. (CONF-471-1)

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963.

The addition of the divertor to the stellarator markedly altered the impurity concentrations. Oxygen ion concentrations were determined from measured intensities of the resonance multiplets of the various states of ionization in a typical hydrogen discharge. The total oxygen concentration appears to be only about 0.05% of the total plasma density. Attempts to determine electron temperatures from measured light intensities were also made. Temperatures were also obtained by other means, notably from electrical conductivity measurements. The conductivity appears to provide reliable temperature measurements in helium discharges. The results were less satisfactory with hydrogen discharges. (D.C.W.)

21379 (N63-13602) RESEARCH ON THE COLLISION PROBABILITIES OF ELECTRONS AND CESIUM IONS IN CESIUM VAPORS. Quarterly Status Report No. 3, November 1, 1962–January 31, 1963. R. H. Bullis and R. K. Flavin (United Aircraft Corp., East Hartford, Conn.). Contract Nasr-112. 15p. (A-920057-3)

Topics included are: the measurement of the total collision cross section of cesium ions with cesium atoms in the energy range of 0.1 to 10 ev by a modified Ramsauer apparatus which uses an electro-formed copper collision chamber; modification of the re-entrant type slits on the collision chamber to improve the uniformity of the electroplating in this area; modification of the ion multiplier to include deflection plates in the front of the first dynode; fabrication of the components for the vacuum system; determination of the electron-cesium atom collision cross section by microwave spectrometric measurement of the width of the electron cyclotron resonance absorption spectra of a cesium plasma in a magnetic field; prediction of the velocity dependence of the collision frequency for momentum transfer by examining the detailed structure of the absorption spectra; and a computer program for solving the collision frequency integral for the derivative of the absorption coefficient, where the collision frequency velocity dependence is approximated by a simple power law. (auth)

21380 (NASA-TM-X-50732) THE A.C. CONDUCTIVITY OF A PLASMA. C. S. Shen and R. L. W. Chen (National Aeronautics and Space Administration. Goddard Inst. for Space Studies, New York). [1962]. 23p. (N63-23039)

The electrical conductivity of a fully ionized spatially homogeneous plasma under the influence of a uniform periodically-alternating electric field is calculated. The velocity distribution of the electrons is determined by solving the linearized Fokker-Planck equations. All the terms in the collision integral are retained, including those representing electron-electron interactions. (auth)

21381 (NASA-TN-D-2071) ELECTROMAGNETIC WAVE PROPAGATION IN A COLD, COLLISIONLESS ATOMIC HYDROGEN PLASMA. Richard R. Woollett (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1964. 123p.

The characteristics of electromagnetic wave propagation in a cold, collisionless plasma immersed in a steady, uniform magnetic field are presented in dimensional units. Data for the principal waves are presented as curves of wave number, wavelength, phase velocity, and group velocity as functions of frequency. Wave numbers for oblique propagation are presented for angles of 0.1 1, 10, 45, 80, 89, and 89.9° relative to the magnetic-field direction. The range of magnetic-field strengths covered by the plots is 10^2 to 10^5 gauss, and the range of electron densities is 10^{10} to 10^{15} ions/cc. Cut-off and resonance frequencies are also plotted as functions of density and magnetic-field strength. (auth)

21382 (NASA-TN-D-2273) FREQUENCY RANGES FOR EXISTENCE OF WAVES IN A COLD, COLLISIONLESS HYDROGEN PLASMA. Richard R. Woollett (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Apr. 1964. 29p.

The dispersion relation of an electromagnetic wave propagating in a cold, collisionless plasma at an arbitrary angle with the magnetic field was solved for an atomic hydrogen plasma. The results indicate that wave propagation is not possible for all values of frequency if the density, magnetic-field strength, and axial wavelength are held constant. Those regions of the frequency spectrum where wave propagation is possible are referred to as existence regions. Within these regions, bounded, cold collisionless plasmas exhibit natural modes of oscillation. Consequently, if experimental data fall in an existence region, the model of a cold collisionless plasma might be used to describe the phenomenon. The existence regions are determined for a range of magnetic fields from 10^2 to 10^5 gauss, a range of ion densities from 10^{10} to 10^{14} ions/cc, and a range of selected axial wavelengths from 10 to 100 cm. The computations are compared with those resulting from an approximate dispersion relation that neglects the effects of electron inertia. (auth)

21383 (NP-13852) THE MOTION OF A CHARGED PARTICLE IN A CONSTANT HOMOGENEOUS MAGNETIC FIELD AND A TRANSVERSE STANDING ELECTROMAGNETIC WAVE AT CYCLOTRON RESONANCE. Rijnhuizen Report No. 63-14. S. Kulinski (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Nov. 1963. 23p.

It is shown that the motion along the magnetic field B_0 obeys a second order differential equation which resembles the one for motion in a one-dimensional potential field. The singularity occurring in the small amplitude, time average theory at cyclotron resonance is thus removed. A criterion (relating the velocity upon entering the electromagnetic field region to the field strength) which predicts whether the particle is reflected or transmitted, is derived. Expressions for the energy exchange between the electromagnetic field and particle are derived for the case in which the field variation along B_0 is sinusoidal for both arbitrary and purely parallel initial velocity. If the initial velocity is such that the particle is neither reflected nor transmitted, it approaches the plane of maximum electric field asymptotically and continues gaining energy indefinitely. (auth)

21384 (NP-13853) METHOD OF MEASURING TIME RESOLVED ELECTRON DENSITY AND ION TEMPERATURE OF PLASMAS WITH A FABRY-PEROT ETALON. Rijnhuizen Report No. 64-17. R. Mewe and R. F. De Vries (Stichting Voor Fundamenteel Onderzoek der Materie. Instituut Voor Plasma-Fysica, Jutphaas, Netherlands). Jan. 1964. 33p.

Electron density and ion temperatures in the regions $10^{14}-10^{18}$ cm^{-3} and 10^5-10^{8}°K respectively can be obtained from the Stark and Doppler broadening of spectral lines. Measurements can be performed with a Fabry-Perot etalon which has spacers of thickness less than 1 mm. A simple method is presented for obtaining the time-resolved half-width of spectral lines with a time resolution better than 0.1 μsec during a scan of about 10 μsec. From the ratio of the minimum and the maximum intensity in the Haidinger pattern, the true half-width of a spectral line can be determined, assuming the spectral line has a Voigt profile. As an example the profiles of the Balmer lines H_β and H_δ and of He II λ3203 according to the Griem-Kolb-Shen theory, are approximated by Voigt profiles for several ion temperatures. From the full half-width of these profiles the electron density can be obtained. (auth)

21385 (NP-13863) HYDROMAGNETIC WAVES IN A CURRENT CARRYING PLASMA COLUMN WITH NON-UNIFORM MASS DENSITY. Gerald W. Pneuman (Purdue Univ., Lafayette, Ind. School of Aeronautical and Engineering Sciences). Aug. 1963. 133p. (A&ES-63-7)

The axially symmetric modes of propagation of hydromagnetic disturbances in a current carrying plasma column with a nonuniform mass density distribution are investigated. The current density is assumed to be uniform and the column is surrounded by a vacuum. In the limit of small discharge current, two uncoupled modes of oscillation can take place. One involves a radial pulsation against the externally imposed axial magnetic field with associated pressure, density, and temperature fluctuations, while the other is a torsional motion. The torsional mode is not accompanied by fluctuations in the thermodynamic properties. The properties of the radial waves in a non-uniform column are investigated and found not to be markedly different than those for a column of uniform density with the exception that the phase velocity and cut-off frequency are considerably higher. Due to the density gradient in the column, the radial wave is confined largely near the column axis, especially at high frequencies. This is due to refraction produced by variation in the Alfvén speed across the column. As opposed to the radial waves, the torsional wave is radically altered by the presence of a density gradient. The phase velocity is exactly the Alfvén speed based upon the local density and, therefore, a function of the radial distance from the center of the column. For a given frequency, the wave length is also variable changing from a minimum value at the center to infinity at the plasma-vacuum interface. Thus, an original plane disturbance will become distorted as it moves down the column. Due to the difference in phase, the axial current density and space charge density, which are functions of the gradients of the field quantities, increase with distance from the source. The total current, however, is always zero and the total charge per unit length does not grow but fluctuates in time balanced by an equal and opposite fluctuation at the surface. The attenuation of both the radial and torsional modes due to resistivity and viscosity is calculated using an energy principle. It is found that the attenuation of the torsional mode is greatly increased due to the increase in axial current density and radial velocity gradient as the wave progresses. (auth)

21386 (NYO-10434) FINITE AMPLITUDE COMPRESSION WAVES IN A COLLISION-FREE PLASMA. K. W. Morton (New York Univ., New York. Courant Inst. of Mathematical Sciences). Jan. 15, 1964. Contract AT (30-1)-1480. 107p.

Adiabatic two-fluid equations are set up to describe the one-dimensional motion of a collision-free plasma. These are then used in a study of finite amplitude compression waves, which is built around the consideration of a "magnetic piston problem." The asymptotic behavior of small amplitude waves is considered. It is found to give a simple but qualitatively correct picture of how the flows depend upon the two parameters θ, the angle the initial magnetic field makes with the direction of wave propagation, and ϵ^2, the electron-ion mass ratio. When $\tan\theta > \epsilon^{-1} - \epsilon$, the main wave front is followed by an oscillatory wave train on the scale of the geometric mean of the ion and electron gyromagnetic radii; otherwise, the front is preceded by an oscillatory precursor on the scale of the ion gyromagnetic radius. A study is carried out of the steady flows that are useful in the solution of the piston problem. Their character depends markedly on the parameters θ, ϵ^2, and the Alfvén Mach number M_A. The relationship to the corresponding one-fluid flows emerges and the effect of intro-

ducing friction forces is also considered. The piston problem is solved numerically using finite differences. The results clearly show that the behavior deduced from the asymptotic theory and the steady flow is substantially correct, even quantitatively so in many cases. (auth)

21387 (NYO-10435) ASYMPTOTIC DESCRIPTION OF THE CUSPS OF A HYDROMAGNETIC FIGURE OF EQUILIBRIUM. Robert E. Dowd (New York Univ., New York. Courant Inst. of Mathematical Sciences). Feb. 1, 1964. Contract AT(30-1)-1480. 77p.

Asymptotic formulas are derived for the cusps of the simplest cusped geometry, which is a spindle-shaped figure consisting of two tapered circular cones set back to back. This figure thus has one circular knife-edged cusp where the cones are joined and two identical axisymmetric point cusps. The spindle is supposed to contain a plasma which is considered a fluid at rest and therefore at constant pressure. An external vacuum magnetic field due to a quadrupole at infinity balances the fluid pressure. (auth)

21388 (TID-20491) BIVARIATE DISTRIBUTION FUNCTION FOR A PLASMA IN A MAGNETIC FIELD. Plasma Physics Bulletin, Vol. 3, March 1963. Roger F. Polcyn (Miami, Fla. Univ., Coral Gables). Contract AT(40-1)-2761. 9p.

The methods of Brownian motion are used to describe the diffusion of electrons and ions in a plasma across a magnetic field in the presence of an anisotropic dynamical friction. The bivariate distribution function of a plasma in a magnetic field and the partial differential equation which it satisfies are found, and the distribution function is used to calculate the diffusion coefficients. (auth)

21389 (TID-20509) PLASMA PHYSICS BULLETIN. VOLUME 1, MARCH 1964. (Miami. Univ., Coral Gables, Fla.). Contracts AT(40-1)-2454 and AF19(628)-2844. Includes one paper: DIFFUSION OF PLASMAS ACROSS A MAGNETIC FIELD. Harry S. Robertson. 26p.

Experimental investigation of transport processes in cesium arc plasmas shows classical ambipolar diffusion across low magnetic fields, convective transport associated with the helical instability at intermediate fields, and a return, apparently to diffusive transport and relatively good confinement at magnetic fields ten to twenty times the critical field for the onset of the instability. Improved confinement is also achieved by using a hysteresis in the parameter space of the plasma operation, a procedure which may have wide applicability. (auth)

21390 (UCRL-7330) STABILITY OF ANISOTROPIC PLASMA AGAINST OSCILLATIONS OF THE RAYLEIGH-TAYLOR TYPE. Terry Kammash (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 15, 1963. Contract W-7405-eng-48. 8p.

The dispersion equation for longitudinal oscillations in an infinite collisionless anisotropic plasma in a magnetic field is analyzed. It is shown that anisotropy in the velocity distribution of the plasma cannot lead to instabilities of the Rayleigh-Taylor type. (auth)

21391 AN INVESTIGATION OF HALL PROPULSOR CHARACTERISTICS. H. E. Brandmaier, J. L. Durand, M. C. Gourdine, and A. Rubels (Curtiss-Wright Corp., Wood-Ridge, N. J.). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 674-81(Apr. 1964).

The steady, one-dimensional, inviscid magnetogasdynamic flow equations are derived for the coaxial, constant area, Hall propulsor using a slightly ionized plasma. For the case of a radial magnetic field and axial electric field, flow regimes are established for which supersonic acceleration combined with an increasing axial Mach number is possible. These are functions of the ratio of the Hall parameter to one plus the "ion slip" parameter, designated as $\tan\phi$, Mach number, and a nondimensional quantity involving the axial and azimuthal plasma velocities and the electric and magnetic field strengths. For each value of $\tan\phi$ there is a maximum attainable axial Mach number. It is further shown that for large $\tan\phi$ the maximum final velocity is just $\gamma/(\gamma - 1)$ times the initial or, for $\gamma = 5/3$, $(V_z \text{ max}/V_z \text{ initial}) = 2.5$. This velocity can be increased by staging in such a manner that the maximum Mach number is approached, thereby minimizing the overall static temperature rise through the propulsor. An experimental model was designed and fabricated to verify the predictions of the analytical investigation. Experimentation is currently being conducted using a radio-frequency generated plasma. 23 references. (auth)

21392 HEAT TRANSFER DUE TO HYDROMAGNETIC CHANNEL FLOW WITH CONDUCTING WALLS. K. Jagadeesan (Indian Inst. of Tech., Kharagpur, India). AIAA (Am. Inst. Aeron. Astronaut.) J., 2: 757-8(Apr. 1964).

The effect of wall conductance on the steady, incompressible, hydromagnetic, fully developed channel flow in the presence of heat transfer is considered. Temperature profiles are given. (R.E.U.)

21393 VORTEX FLOW IN ARC HEATERS. K. E. Tempelmeyer and L. E. Rittenhouse (Arnold Engineering Development Center, Arnold AF Station, Tenn.). AIAA (AM. Inst. Aeron. Astronaut.) J., 2: 766-7(Apr. 1964).

Some effects of vortex flow, which is used to induce arc rotation and thereby minimize electrode erosion, on the operation of Gerdien-type and constricted-arc heater configurations are discussed. The validity of applying irrotational energy exchange theories to vortex-flow or gas-stabilized arc heaters is studied. (R.E.U.)

21394 MICROWAVE EMISSION IN AN ELECTRODELESS INDUCTION DISCHARGE. I. Yu. Adamov, L. A. Dushin, V. I. Kononenko, O. S. Pavlichenko. At. Energy. (USSR), 16: 99-103(Feb. 1964). (In Russian)

The emission of microwaves (wavelength $\lambda = 3.2$, 0.8, and 0.4 cm; intensity > 0.01 volt) was measured in a hydrogen plasma confined by a 11 cm diameter, 20 cm long solenoid, which was powered by a 5 to 30 kv, 18 μf capacitor bank. The maximum field was 16,500 oersted; the field oscillated with an 8.6 μsec period. The plasma had a density of 10^{12} to 7×10^{13} cm^{-3} and a diameter of 3 to 4 cm, as determined by the absorption of microwaves ($\lambda = 0.2$ to 3.2 cm). X rays, as detected by a scintillator system, appeared simultaneously with the microwaves at an energy of 20 to 25 kev. The electron temperature was about 3×10^{5}°K. The ambient pressure varied from 1.2×10^{-2} to 5.4×10^{-4} torr. The maximum microwave emission occurred during the third half-period of the magnetic field, and when the plasma energy exceeded a threshold value (5 kev for $\lambda = 3.2$ cm, 10 kev for $\lambda = 0.8$ cm), the intensity of the microwaves of a given λ increased slightly as the plasma energy was raised above the threshold value to 30 kev. The microwaves disappeared both when the ambient pressure exceeded 10^{-2} torr (all λ), and when it fell below a threshold value (10^{-3} torr for $\lambda = 3.2$ cm, 2.2×10^{-3} torr for $\lambda = 0.8$ and 0.4 cm); the maximum emission occurred at 5×10^{-3} torr (all λ). The microwaves were formed by the excitation of electron plasma waves, which were transformed into transverse electromagnetic waves. (TTT)

21395 SOLID STATE PLASMA PHENOMENA. A. K. Jonscher (Chelsea Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 365-77(Apr. 1964).

The similarities and differences between gaseous and solid state plasmas are reviewed. The principal solid state plasma phenomena are discussed. These include analogues of known gaseous phenomena, such as passive propagation of electromagnetic waves, propagation of growing waves, magnetohydrodynamic generation, and gas discharge. Some specifically solid state phenomena are also described, including acoustoelectric interaction and plasmon excitation. (auth)

21396 EXCITATION OF COUPLED ELECTRO-ACOUSTICAL WAVES BY A RING SOURCE IN A COMPRESSIBLE PLASMA CYLINDER. S. N. Samaddar and M. Yildiz (Raytheon Co., Wayland, Mass.). Can. J. Phys., 42: 638-56(Apr. 1964).

Propagation of coupled electromagnetic and plasma waves (acoustical) excited by a magnetic ring current in an infinitely long compressible plasma cylinder surrounded by vacuum is studied. It is known that in an incompressible plasma a slow surface wave can propagate only when the electron-plasma frequency, ω_p, is higher than the frequency, ω, of the source. However, in the present problem it is shown that under suitable conditions slow surface waves can propagate along the interface of the compressible plasma column and vacuum for values in the range either $\omega_p > \omega$ or $\omega_p < \omega$. The surface waves for which $\omega_p < \omega$ are supposed to be a new phenomenon. Numerical results for these surface waves are presented. In addition, an expression for a radiated field is obtained by the usual saddle-point method of integration. The possibility of the existence of leaky waves is also discussed for a special case. (auth)

21397 THERMAL CONDUCTIVITY OF A FULLY IONIZED GAS. M. K. Sundaresan (Carleton Univ., Ottawa) and Ta-you Wu. Can. J. Phys., 42: 794-813(Apr. 1964).

The theory of the hydrodynamical stage in the approach of a plasma towards equilibrium is dealt with on the basis of the kinetic equation obtained by Guernsey and by Rosenberg and Wu along the line of the Bogoliubov theory for neutral gases. The equations of continuity, momentum transport, and energy transport are given. The solution of the kinetic equation is obtained in the hydrodynamical stage for a plasma deviating only slightly from equilibrium. This solution is used to calculate the thermal conductivity of the plasma. The result agrees very well with an earlier calculation of Spitzer and Härm based on the use of a Fokker-Planck kinetic equation with a Debye-Hückel screened potential to avoid the divergence for distant collisions. (auth)

21398 THE CRITICAL MAGNETIC FIELD AND ANOMALOUS DIFFUSION IN A WEAKLY IONIZED PLASMA. A. M. Fridman (Novosibirsk State Univ., USSR). Dokl. Akad. Nauk SSSR, 154: 567-70(Jan. 21, 1964). (In Russian)

If the frequency of a plasma oscillation $\omega \ll \omega_i$, the ion cyclotron frequency, instabilities can be explained by a drift wave whose phase velocity is the same as the electron drift velocity. However, in the range $\omega_i \ll \omega \ll \omega_e$ (ω_e = electron cyclotron frequency), this wave is attenuated, but instabilities can be explained by an antidrift wave. The equations for the antidrift wave were derived for a one-dimensional perturbation of the electric potential $\delta\phi$ for a weakly ionized multicomponent plasma in which $T_e \gg T_i$, and $\omega_i/\nu_{in} \ll 1$ and $\omega_e/\nu_{en} \gg 1$, where ν_{in} and ν_{en} are the collision frequencies of ions and electrons with neutral particles. If it is assumed that the logarithm of the particle density varies as $(1 - x^2/R^2)$, where R is the plasma radius, the equation for $\delta\phi$ is the same as the Schroedinger equation for a linear oscillator with complex energy and frequency. The critical magnetic field B_c is given by $B_c \sim (c/e)(T_e m_e m_i \nu_{en} \nu_{in}/R^2)^{1/4}$, where m_e and m_i are the electron and ion masses. B_c varies as the square root of the plasma pressure. (TTT)

21399 PLASMA DIAGNOSTICS IN SUPERSONIC FLOW CONTAINING CESIUM AND POTASSIUM. K. Baldwin (AVCO Corp., Wilmington, Mass.) and W. Balwanz. IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 51-63(Apr. 1964).

Electron density, collision frequency, and electron extinction rates were computed from microwave absorption measurements on the exhaust plumes of solid propellant rocket motors burning $CsNO_3$: Al and KNO_3: Al. The plasma was generated by burning the fuel at a chamber pressure above 100 psi, and expanding the gases through an orifice to an ambient pressure of 1 torr. The plume consists of both gases and solid particles, which modify the aerodynamic flow. High-speed movies together with grid wires in the flow field were used to define the plume. Microwaves operating at frequencies up to 70 Gc were used for measuring the plasma properties. (auth)

21400 FREE ENERGY OF A PLASMA AT INFINITE DILUTION. A. Bellemans (Université Libre, Brussels). J. Chem. Phys., 40: 2236-8(Apr. 15, 1964).

The electrostatic free energy of a finite plasma is expanded in semi-invariants, which are conveniently represented by diagrams corresponding to clusters of interacting particles. At infinite dilution the free energy is related to unbranched linear diagrams as well as to ring diagrams. For a macroscopic system only the contribution of the ring diagrams is significant. (auth)

21401 HIGH-FREQUENCY CONDUCTIVITY OF PLASMAS. Osamu Aono (Tokyo Univ.). J. Phys. Soc. Japan, 19: 376-80(Mar. 1964).

The unified theory is applied to oscillatory phenomena. As an example the response of two-component plasma to high-frequency electric fields is investigated. The increment of the plasma frequency and damping coefficient of the plasma oscillation are obtained. (auth)

21402 ON THE RELATIONSHIP BETWEEN THE DEFORMATION OF THETA PINCHED PLASMA AND THE INHOMOGENEITY OF MAGNETIC FIELD. Yasumasa Takeda, Tetsu Miyamoto, Haruyuki Ohnishi, and Masahiro Yokota (Nihon Univ., Tokyo). J. Phys. Soc. Japan, 19: 411(Mar. 1964).

In a low field theta pinch experiment it was observed that the compressed plasma column was deformed and drifted toward the wall of the discharge tube. It was found that the deformation and drift were due to a small inhomogeneity of the magnetic field at the center of magnetic mirrors. (C.E.S.)

21403 E-vs-B CURVE HYSTERESIS IN THE POSITIVE COLUMN IN A MAGNETIC FIELD. Shingo Imazu, Yasumasa Uesaka, Takashi Sukegawa, and Yoshiei Nakano (Tokyo Univ.). J. Phys. Soc. Japan, 19: 418(Mar. 1964).

To study the diffusion of plasma in the positive column in a longitudinal magnetic field, the electric field along the tube was measured. A discharge tube containing helium was used. A hysteresis effect, which was dependent on gas pressure and discharge current, was observed. (C.E.S.)

21404 COLLISION DAMPING OF PLASMA WAVE IN A WEAK MAGNETIC FIELD. Utaro Furukane (Hiroshima Univ.). J. Phys. Soc. Japan, 19: 420-1(Mar. 1964).

The collision damping coefficients of plasma waves in the long wavelength region are calculated by means of the

Maxwell equation and the Boltzmann equation with Fokker-Planck collision terms representing electron-electron and electron-ion encounters. An unbounded, fully ionized plasma close to thermal equilibrium is treated. (C.E.S.)

21405 ON ONE GENERALIZATION OF STATISTICAL THEORY ON BROADENING SPECTRAL LINES IN PLASMA. V. I. Kogan (Kurchatov Inst. of Atomic Energy, Moscow). J. Quant. Spectr. Radiative Transfer, 4: 243-8 (Mar.-Apr. 1964). (In Russian)

The thermal motion of perturbing ions in a plasma causes a deviation of the broadened atomic spectral line shape from its "static" shape. Calculations of this effect in the adiabatic approximation, taking account of the simultaneous action of all (mutually non-correlated) plasma ions on the radiating atom, were carried out. The cause of discrepancy with other calculations was analysed, and the results of others are shown to be erroneous. In particular, the results disagree in the limit of the line wing with the binary result and also restrict excessively the applicability. The discrepancy is shown to be due to an error that amounts to the tacit neglect of the field dependence of certain expansion coefficients. Taking into account the above dependence leads exactly to earlier results that predict thermal corrections to the original theory of a much more moderate magnitude. (P.C.H.)

21406 HEAVY PARTICLE TEMPERATURE MEASUREMENTS IN A NITROGEN PLASMA BY A SPECTROSCOPIC METHOD. D. Robinson (Univ. of Southern California, University Park). J. Quant. Spectr. Radiative Transfer, 4: 335-42(Mar.-Apr. 1964).

The measurement of heavy particle temperatures in a plasma is best made by a spectroscopic technique. The rotational line intensity method was developed for a plasma containing nitrogen and the theory applied to the N_2 second positive system emitted from a gas stream after expansion through a Mach 6 low density nozzle and excitation by a radio-frequency discharge. Good agreement was obtained between the temperatures calculated for different vibrational bands and at different positions in the hypersonic gas stream. (auth)

21407 "PHOTON-DRAG" IN SOLIDS AND PLASMAS. J. W. Gardner (English Electric Co. Ltd., Whetstone, Leicester, Eng.). Nucl. Energy, 92-8(Apr. 1964).

The interaction between photon flux and free electrons in both condensed media and plasma is considered. Mutual dragging between photons and electrons could become macroscopically significant if, (a) the radiation flux were sufficiently intense to offset the smallness of the normal photon-electron coupling, or, (b) if anomalously large coupling were to obtain in special situations. Known sources of collimated radiation, ranging from lasers to nuclear reactors, are shown not to give a practically useful efficiency for the direct conversion of radiation to electric current, but the possibility of effects such as (b) should be kept under review as laser technology continues its rapid advance. It is also shown that the intense isotropic radiation flux in a thermonuclear plasma can make a nontrivial contribution to the plasma resistivity. (auth)

21408 RADIATION COOLING OF A GAS HEATED BY A POWERFUL SHOCK WAVE. V. G. Sevastyanenko and I. T. Yakubov. Opt. Spectry. (USSR) (English Transl.), 16: 1-5(Jan. 1964).

Behind the front of a strong shock wave, there is a region containing a hot, highly luminous gas. The loss of energy by radiation leads to cooling of the gas. This cooling was investigated experimentally in shock tubes filled with argon. The rate of cooling is calculated. An energy balance is set up for the energy radiated by the inert gas, and the system of equations describing the state of the gas behind the wave front is solved. Good agreement was obtained between theory and experiment. (auth)

21409 THE BROADENING OF SPECTRAL LINES IN A STRONGLY IONIZED PLASMA. III. WAVELENGTHS OF THE LINES OF MULTIPLY CHARGED IONS. M. A. Mazing and N. A. Vrublevskaya. Opt. Spectry. (USSR) (English Transl.), 16: 6-8(Jan. 1964).

The widths and spectral location of lines of the multiply charged ions Al III, Sn IV, Si III, and Si IV are investigated experimentally in sources of widely differing electron densities. It is shown that the wavelengths of a number of lines, measured in the different sources, may deviate appreciably from each other, and may differ from the true wavelength corresponding to radiation emitted by the unperturbed atom at zero electron density. (auth)

21410 MAGNETOPLASMADYNAMIC CHANNEL FLOW AND ENERGY CONVERSION WITH HALL CURRENTS. James T. Yen (Univ. of North Carolina, Raleigh). Phys. Fluids, 7: 723-9(May 1964).

Several new complex parameters and several new real and complex functions are introduced for the first time. It is found that they are fundamental to this problem and hence to other problems involving Hall currents. Several conclusions on channel flow and energy conversion are obtained. In particular, it is shown under what conditions a mixed type generator can be more efficient than both the corresponding Hall current and ordinary-type generators. Moreover, it is shown that in a Hall current pump, it is unnecessary to require a zero net Hall current. With viscous effects, a suitable net Hall current and transverse loading combination may produce an optimum pumping. (auth)

21411 KINETIC THEORY OF AN ELECTRON-PHOTON GAS. H. Dreicer (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 7: 735-53(May 1964). (LADC-5249)

An extension of the Boltzmann equation for plasmas is presented, including interactions between the electrons and the photons which populate the radiation field. This development results in those electron–photon collision integrals which are required to describe relaxation towards equilibrium of both particles and radiation field as a result of radiative interactions alone. Single-photon emission and absorption as well as Compton scattering are treated. The equation derived is specialized to the case of electrons orbiting in a steady magnetic field and is used to follow the relaxation of a test electron which is interacting with a thermal radiation field via the emission and absorption of cyclotron radiation. It is also used to study the saturation properties of the cyclotron radiation maser. In the case of Compton scattering by free electrons a clear separation between these electron–photon collision terms and the usual electric field term in the Boltzmann equation is shown to exist. Collision terms are also derived for the photon transport equation, with particular attention paid to the effect of enhanced scattering when more than one mode of the radiation field is simultaneously occupied. This equation is then used to evaluate a new type of light scattering experiment, one which involves the enhanced Compton scattering by free electrons traversing an intense radiation field excited in two of its modes. The entire treatment is based upon independent particle behavior. Many-body collective effects are ignored. (auth)

21412 INSTABILITY OF AN ALTERNATING-CURRENT POSITIVE COLUMN. Henry F. Rugge and Robert V. Pyle (Univ. of California, Berkeley). Phys. Fluids, 7: 754-9 (May 1964). (UCRL-10698(Rev.))

The positive column of a glow discharge in a magnetic field is known to become macroscopically unstable at some critical magnetic field. The driving mechanism proposed by Kadomtsev and Nedospasov for the growth of a helical (m = 1) perturbation is such that the periodic reversal of the axial electric field at a frequency greater than a critical frequency would be expected to lead to stability. This critical frequency is expected to be approximately the e-folding rate. An experimental study was made in d-c and half-wave rectified-current discharges and in square and sinusoidal a-c glow discharges in H_2, D_2, He, Ne, and Ar at frequencies as high as 70 kcps. Over a wide range of frequencies the half-wave rectified discharges yielded instabilities whose onset and helical nature duplicated those of the d-c cases. However, the instability in the a-c discharges was indeed suppressed as the frequency of electric field reversal was increased. The frequency-dependent suppression of the instability is compared with theoretical growth rates. The effect of including several m modes is calculated and good qualitative agreement is obtained with the Kadomtsev and Nedospasov model. However, better quantitative agreement is obtained when the Johnson and Jerde modification is employed. (auth)

21413 CALCULATIONAL TECHNIQUE FOR STABILITY INTEGRAL GRADIENTS. H. Hurwitz, Jr. (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 7: 762-3(May 1964).

A technique for obtaining stability integral gradients in plasma equilibrium studies is presented. The technique is based on the introduction of an artificial hamiltonian whose associated action integral may be identified with integrals along magnetic field lines. (C.E.S.)

21414 CLOSED MAGNETIC VACUUM CONFIGURATIONS WITH PERIODIC MULTIPOLE STABILIZATION. Harold P. Furth (Univ. of California, Livermore) and Marshall N. Rosenbluth. Phys. Fluids, 7: 764-6(May 1964). (UCRL-7707)

It is shown that a previously presented equation for plasma containment in regions of maximum field strength can also be satisfied with closed magnetic vacuum configurations with periodic multipole stabilization. (C.E.S.)

21415 ION GYRO-RADIUS EFFECTS AND STABILIZATION OF PLASMA DISSIPATIVE MODES. Bruno Coppi (Stanford Univ., Calif.). Phys. Rev. Letters, 12: 417-19 (Apr. 13, 1964).

It is shown that the ion gyroradius effects strongly slow the growth rates of instabilities, but broaden the region where they occur. The perturbed linearized form of the macroscopic equations, derived from the Fokker-Planck equation, is developed. A sheet pinch configuration is considered. (L.B.S.)

21416 ROLE OF COMPRESSIBILITY IN THE MAGNETOHYDRODYNAMICAL STABILITY OF THE DIFFUSE PINCH DISCHARGE. A. A. Ware (Culham Lab., Abingdon, Berks, Eng.). Phys. Rev. Letters, 12: 439-41(Apr. 20, 1964).

It is shown that the retention of compressibility in growth rate calculations removes the stability-condition discontinuity at $k_{||} = 0$ for field-curvature as well as gravitational modes and leads to stability predictions more in agreement with experiment. (M.J.T.)

21417 COMMENT ON "SINGLE-PARTICLE CYCLOTRON RADIATION NEAR WALLS AND SHEATHS," BY A. SIMON AND M. N. ROSENBLUTH. Joseph Slepian. Proc. Natl. Acad. Sci. U. S., 51: 592-3(Apr. 1964).

Power-loss calculations for cyclotron radiation from a charged particle moving perpendicular to a magnetic field previously presented (NSA 17: 42116) are reviewed and some disagreement is found with experimental results. (R.E.U.)

21418 ON THE ATTAINABILITY OF FUSION TEMPERATURES UNDER HIGH DENSITIES BY IMPACT SHOCK WAVES OF SMALL SOLID PARTICLES ACCELERATED TO HYPERVELOCITIES. F. Winterberg (Case Inst. of Tech., Cleveland). Z. Naturforsch., 19a: 231-9(Feb. 1964). (In German)

It is shown that temperatures up to 10^8°K and densities of the order 1 g/cm^3 are attainable in liquid tritium-deuterium by the impact shock waves of small solid particles accelerated up to velocities of some 10^7 cm/s in heavy particle accelerators. The high temperatures occurred in a focused particle beam. It is shown that under feasible conditions, the particle beam will generate in the target material a shock wave of the required strength. The particles are charged electrically up to the limit of mechanical breakup and then are accelerated in linear particle accelerators to the required velocities. In order to cut down losses by bremsstrahlung radiation, the particles must consist of low Z-value material. The most promising substances in this regard are lithium and beryllium. The "guillotine factor" is of significance at high densities and reduces the bremsstrahlung losses by a factor of about $\frac{1}{3}$. The attainable temperatures are high enough to reach the lowest ignition temperatures for thermonuclear reactions. Apart from the prospect of high-temperature, high-density experiments, the possibility of igniting a small fusion explosion of controllable size by this method is considered. (auth)

21419 ON THE PINCH EFFECT AT HIGH GAS DENSITY. Hartmut Zwicker (Technische Hochschule, Hanover). Z. Physik, 177: 54-67(1964). (In German)

The characteristic changes in the termination of the pinch effect by increasing the initial pressure were investigated with cinematographic and electric measuring methods in argon and helium. At small initial pressures (corresponding to 0.1 torr He) the termination of the discharge by one of the cylindrical shock waves converging on the vessel axis and a following compression by the stimulated conducting layer are discussed. At higher initial pressures (corresponding to 11 torr He) the shock wave alone caused the heating and density increases in the vessel axis. The instability of the compressed plasma column declined almost completely with increasing initial pressure. As a reason for this the incomplete particle sharing during compression was considered, since it led to the flow of essential currents after the pinch outside the compressed column. (tr-auth)

21420 NOTES ON NUMBER DENSITY FLUCTUATIONS AND THE SCATTERING CROSS SECTION FOR ELECTROMAGNETIC WAVES SCATTERED FROM A THERMAL NONEQUILIBRIUM PLASMA. Jacques Renau (Cornell Aeronautical Lab., Inc., Ithica, N. Y.). Z. Physik, 177: 458-94(1964).

The scattering cross section and the Doppler spectrum for electromagnetic waves scattered by the electron density fluctuations of a plasma, where the mean kinetic temperature of the electrons T_e may differ from that of the

ions T_i, was obtained among others, by Fejer, Buneman, Renau, Camnitz, Flood, and Salpeter. Different methods of approach were used to calculate the autocovariance of the electron number-density fluctuations (from the mean) and then obtain the scattering cross section. Because of the differing results, the methods, concepts, and derivations of the scattering cross section were carefully examined. It is shown that the short-time dynamical considerations incorporated in the formulation of the statistical theory of the electron number-density fluctuations of plasma as used by several authors leads to results of limited validity. In addition, a fundamental error in calculating the electron density fluctuations leads to an incorrect scattering cross section. The theory of scattering of electromagnetic waves from a plasma, where the electrons are not in thermal equilibrium with the ions but statistical equilibrium exists, was developed in a general way. The covariance of the number-density fluctuations from the mean of the charged species of the plasma and the scattering cross section $\sigma(q)$ were obtained. It is shown that for a wavelength λ much greater than the effective Debye length d, the backscattering cross section increases and approaches complete incoherent scattering as T_e/T_i increases. This result is explained by noting that in the case of thermal equilibrium, the predicted value of the backscattering cross section is smaller than that of the backscattering cross section from completely uncorrelated electron density fluctuations because the electrostatic interaction between the charged particles of the plasma, which is a function of T_e and T_i, introduces a certain amount of organization in otherwise completely uncorrelated electron density fluctuations. The spectrum function of incoherent scattering of electromagnetic waves from a nonequilibrium plasma was obtained and some cases were plotted. (auth)

21421 SPECTROSCOPIC INVESTIGATION ON MAGNETICALLY COMPRESSED DENSE PLASMA. Hartmut Zwicker (Technische Hochschule, Hanover). Z. Physik, 178: 189-99(1964). (In German)

The characteristic indications of the expiration of the pinch effect at high initial pressures in helium and xenon were inferred from the variation with time of the discharge spectra. The wavelength pattern of the continuum intensity of the compressed column was explained as a result of the reabsorption inside the plasma. From the intensity pattern of the pinch continuum, which was measured absolutely between 3500 and 6200 Å, temperature and particle densities in the compressed column of a helium discharge were determined for an initial pressure of 1.5 torr. The results showed that the magnetic compression under these conditions leads to the formation of extremely dense plasmas with particle densities of $N = 4 \times 10^{19}$ cm^{-3} at temperatures of 115000°K. (tr-auth)

21422 HYDROTHERMOMAGNETIC WAVES IN A WEAKLY INHOMOGENEOUS PLASMA. L. E. Gurevich and B. L. Gelmont (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksperim. i Teor. Fiz., 46: 884-901(Mar. 1964). (In Russian)

Two types of instability are possible in an inhomogeneous system: local instability characterizing the development of a local fluctuation and global instability characterizing the behavior of the system as a whole. The second develops from the first and requires more stringent conditions for its realization. Local instabilities of a weakly inhomogeneous plasma possessing a small temperature gradient ∇T or density gradient ∇p or finally a stationary electric field are studied. A system of this type has some special oscillation properties if $\nu_A \ll s$ (ν_A is the Alfven wave velocity, s is the velocity of sound) i.e. if $p \gg {}^2H/8\pi$; in this case one may put $\nabla p = 0$. The case of ∇T and a homogeneous weak magnetic field H was considered previously. The case $\Omega\tau \gtrsim 1$ is considered (Ω is the electron Larmor frequency, τ is their relaxation time). The magnetic field of the thermomagnetic current is neglected. The spectrum consists of six branches, and under certain conditions instability may arise, that is, oscillation growth may begin. For $\Omega\tau \ll 1$ the instability is of a convective nature and may also be manifest in amplification of waves entering the medium from the environment. For $\Omega\tau > 1$ the instability becomes absolute. The increment depends on the mutual arrangement of vectors k, H, and ΔT and is maximal when they are parallel. In the presence of instability an external poloidal field may create a toroidal field and vice versa. This mechanism may be of significance in the creation of the magnetic field of celestial bodies. (auth)

21423 ON SELF-CONSISTENT POTENTIAL FOR LOW-TEMPERATURE PLASMA DENSITY. B. N. Baranov and I. P. Pavlotskii. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 13-18(Nov.-Dec. 1963). (In Russian)

An attempt was made to develop a self-consistent potential for low temperature plasma density. Supplementary self-consistence was imposed on the Poisson-Boltzmann equation. It is shown that an accurate solution cannot be self-consistent. An approximate self-consistent solution in non-Debye approximation and based on the Poisson-Boltzmann equation was suggested. (R.V.J.)

21424 ON THE DELAY AND TRANSFORMATION OF PLASMA ENERGY EXPANDING IN A VACUUM WITH A MAGNETIC FIELD. Yu. P. Raizer. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 19-28(Nov.-Dec. 1963). (In Russian)

Energy transformation during rarefied plasma cloud expansion in a vacuum with a constant, homogeneous magnetic field was studied. Results obtained from applying purely phenomenological theory of superconducting spheres were analyzed. It is shown that delayed plasma undergoes a considerable loss of energy which, together with a certain amount of magnetic energy, concentrated in the central region and was carried away by the electromagnetic field. Microscopic pictures of plasma expansion and the mechanism of plasma interaction with the magnetic field were analyzed. It was assumed that rarefied plasma acts as a superconductor in relation to the external field. The structures of intermediate surface layers in the superconductor follow the Chapman-Ferraro model. (R.V.J.)

21425 TURBULENT DIFFUSION OF WEAKLY IONIZED MAGNETIC PLASMA. G. M. Zaslavskii, S. S. Moiseev, and V. N. Draevskii. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 29-33(Nov.-Dec. 1963). (In Russian)

Hydrodynamic studies of anomalous diffusion of weakly ionized plasma in a strong magnetic field showed that the increment of instability is much lower than the order of frequency. A system of equations for two-fluid hydrodynamics and Maxwell equations was developed for electron and ion collisions with a neutral gas and for electron-ion collisions in a completely ionized plasma. (R.V.J.)

21426 ON THE THEORY OF TURBULENT PLASMA IN A MAGNETIC FIELD. V. I. Karpman. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 34-41(Nov.-Dec. 1963). (In Russian)

The coefficient of anomalous electron diffusion across a magnetic field was calculated for a stationary condition in which the distribution of velocities is such that the wave increments do not disappear, but induce a stationary turbu-

lence in which the wave excitations are compensated by its absorption. It is shown that even with comparably small Coulomb interaction frequencies the stationary oscillation amplitudes are considerably larger than in the quasistationary state investigated by W. Drummond et al. (Phys. Fluids, No. 2, v. 5, 1962) without considerations for wave collisions and interactions. The obtained diffusion coefficient is almost identical to the Baum coefficient. (R.V.J.)

21427 INTERACTIONS OF AN EXPANDING PLASMA CYLINDER WITH AN EXTERNAL MAGNETIC FIELD. V. I. Yakovlev. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 141-3(Nov.-Dec. 1963). (In Russian)

Interactions of an expanding plasma cylinder with a constant magnetic field were analyzed, and the intrinsic efficiency $\eta_i = (A-Q)/\underline{A}$ (where A is plasma work per unit time, and $\underline{Q}$ is Joule losses) was studied as a function of R_m for two cases in which $f(x) = \alpha/x$ (α is an arbitrary constant and $f(x) = \text{const} = \frac{1}{2}$). Before resolving the specific cases, the problem of a homogeneous magnetic field (H_0) with a constant conductivity plasma pinch (σ) parallel to the H_0 vector was resolved. At time $T = 0$ the plasma radius was zero. The ordered pinch velocity was $V = [V(r,t),0,0]$ (cylindrical coordinates). The distribution of magnetic field intensity $H(r,t)$ inside the pinch $0 < r < a(t)$ (where a(t) is pinch radius) at $t > 0$ was determined, and the results were used for constructing the intrinsic efficiency η_i for R_m number. (R.V.J.)

21428 RAYLEIGH-TAYLOR INSTABILITIES IN A CONICAL PLASMA ACCELERATOR. R. Kh. Kurtmullaev, Yu. E. Nesterikhin, and A. G. Ponamarenko. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 6, 144-6(Nov.-Dec. 1963). (In Russian)

An attempt was made to determine the limitations on plasma bunch velocity, density, and temperature parameters and to estimate the ratio between the directional motion and quantity of accelerated material. Theoretical studies predicted the presence of Rayleigh-Taylor instabilities in bunches produced in coaxial and conical fields, showing that the plasma production method itself produces instabilities that limit plasma parameters. Experiments were carried out on hydromagnetic instabilities in conical accelerators. The results showed that instabilities appearing in plasma bunches with optimum parameters complicate not only transport but also injection into traps. (R.V.J.)

21429 ON A SLIGHT DAMPING OF PLASMA WAVES. V. P. Silin (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 236-47(Feb. 1964). (In Russian)

Oscillation spectra of heterogeneous plasma without external fields and with isotropic particle distribution were studied by means of geometric optical approximation. Calculations were made of damping decrements for high-frequency Langmuir waves and ion oscillations. It is shown that at various spatial points various plasma particles participate in wave absorption due to the wave phase velocity dependence on the coordinates. The method of geometric optics was extended to the small integral interdifferential field equations. (tr-auth)

21430 EFFECTS OF FINITE CONDUCTIVITY ON PLASMA STABILITY IN A MAGNETIC FIELD. S. S. Moiseev and R. Z. Sagdeev. Zh. Tekhn. Fiz., 34: 248-53(Feb. 1964). (In Russian)

Effects of finite conductivity on the equilibrium instability of plasma contained by a strong magnetic field were studied by means of two-fluid hydrodynamic approximation. The coefficient of turbulent diffusion of the instability is $(cT)/(2\pi eH_0)$. (tr-auth)

21431 MAGNETOSONIC WAVES IN NONISOTHERMAL PLASMA. A. V. Bogdanov (Moscow Regional Pedagogical Inst.). Zh. Tekhn. Fiz., 34: 254-8(Feb. 1964). (In Russian)

Magnetosonic waves propagating in random directions in nonisothermal plasma were studied using a kinetic method that considered electron-electron interactions. An analysis was also made of the dispersion equation for alpha and magnetosonic waves. (tr-auth)

21432 KINETIC INSTABILITY IN MAGNETIC FIELD. P. V. Polovin. Zh. Tekhn. Fiz., 34: 259-61(Feb. 1964). (In Russian)

It is shown that an even distribution function with one maximum is the main prerequisite for electron distribution stability in relation to long-wave plasma longitudinal oscillations in an external homogeneous field. (tr-auth)

21433 VOLUME RECOMBINATION IN AMBIPOLAR DIFFUSION IN PLASMA GAS DISCHARGE. V. I. Solunskii and B. L. Timan. Zh. Tekhn. Fiz., 34: 262-5(Feb. 1964). (In Russian)

The theory of volume recombination rates in electron loss in gas-discharge plasma was analyzed using a nonlinear differential equation that considered ambipolar diffusion and volume recombination in describing electron density: $(d^2n)/(dx^2) + (1)/(x)(dn)/(dx) + (ZR^2)/(D)n - (\beta R^2)/(D)n^2 = 0$ (where $x = (r)/(R)$, $\underline{r}$ is the distance from the axis of the discharge, $\underline{R}$ is the discharge tube radius, Z, β, and D are ionization, recombination, and ambipolar diffusion coefficients). The results showed the electron loss by volume recombination to be 11% of the electron loss by ambipolar diffusion. This holds for sufficiently large electron concentrations ($n_0 \sim 10^{12}$ cm^{-3}). (R.V.J.)

21434 ON PLASMA EQUILIBRIUM IN SPACE-PERIODIC (UNDULATING) MAGNETIC FIELD. R. A. Demirkhanov, T. I. Gutkin, and T. R. Soldatenkov. Zh. Tekhn. Fiz., 34: 266-8(Feb. 1964). (In Russian)

A solution in magnetohydrodynamic approximation was obtained for a system of equations describing equilibrium for a plasma cylinder confined in a space-periodic magnetic field. (tr-auth)

21435 INVESTIGATION OF SPECTRAL LINE INTENSITY VARIATIONS IN TOROIDAL DISCHARGE WITH A WEAK MAGNETIC FIELD. V. G. Averin, M. A. Mazing, and A. I. Pisanko. Zh. Tekhn. Fiz., 34: 269-71(Feb. 1964). (In Russian)

Intensity variations of O V, F V, O IV, F III, and Ar III spectral lines in toroidal discharges in weak magnetic fields were investigated. Variations in light intensity are related to variations in electron density. Observed frequency variations ranged from 10 to 100 kc. Moreover, correlations of the high frequency O V–F V lines with low frequency F V–F III lines showed that localized electron density variations diminish as the frequency of the variations increases. (tr-auth)

21436 ORDERED PARTICLE MOTION IN ALPHA INSTALLATION. S. A. Bel'skii (Leningrad Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 272-9(Feb. 1964). (In Russian)

A bolometric method was used in an investigation of ordered particle motion in the alpha installation. The magnitudes of electron velocities were evaluated in relation to their thermal velocity across the discharge, assuming that electrons pass through a bolometer at thermal velocities. (tr-auth)

21437 MOTION OF DENSE PLASMA CLUSTERS IN TOROIDAL SOLENOID MAGNETIC FIELD. V. S. Voitsenya, A. G. Gorbanyuk, I. N. Onishchenko, and B. G.

Safronov. Zh. Tekhn. Fiz., 34: 280-7(Feb. 1964). (In Russian)

Studies of dense plasma cluster motion in the magnetic field of a 1000-gauss toroidal solenoid indicated that heavy admixtures are separated from plasma with particle densities of $n \sim 10^{13}$ cm^{-3}, leaving pure plasma clusters. (tr-auth)

21438 PROBE CHARACTERISTICS MEASURED BY VARIOUS TYPE PROBES IN GASEOUS DISCHARGE PLASMA IN CESIUM AND MERCURY VAPORS. N. I. Ionov and A. Ya. Tontegode (Leningrad Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 354-60(Feb. 1964). (In Russian)

Comparative studies were made of the characteristics of electron and ion currents on single, two, three, and four electrode probes. It was established that more complete and correct data on electron and ion distributions can be obtained using three- and four-electrode probes. Measurements were made of electron and ion temperatures in low-pressure cesium and mercury discharge plasmas. (tr-auth)

21439 CALCULATIONS OF TRANSPORT COEFFICIENTS IN TWO-TEMPERATURE PLASMA. M. V. Samokhin. Zh. Tekhn. Fiz., 34: 369-71(Feb. 1964). (In Russian)

A system of algebraic equations previously developed for determining coefficients of electron and ion transport was used to obtain the numerical magnitudes for two-temperature plasma transport. The data, which agree with those in a previous article by the author (Zh. Teoret. Fiz., 33, 667, 1963), are tabulated. It was also observed that an expansion according to a multidimensional hermitian polynomial in linear approximation for λ/L can be reduced to a $^3/_2$ power Laguerre polynomial. (R.V.J.)

21440 ON PLASMA RESONANCES IN HETEROGENEOUS OBJECTS. V. B. Gil'denburg (Gorkii State Univ., USSR). Zh. Tekhn. Fiz., 34: 372-4(Feb. 1964). (In Russian)

The theory of confined plasma high-frequency oscillations determined by the relative distribution of resonance lines, $\omega_k^2 = \omega_p^2[1 + 6\pi^2(2k-1)^2\,(D/L)^2]$ $(D \ll L)$, $k = 1, 2, 3 \ldots$ (ω_p is plasma frequency, D is Debye radius, L is object dimensions), does not agree with experimental data in which the intervals between adjoining lines narrow in the direction of increasing ω. The inconsistency arises because of a postulated homogeneous electron concentration (n) inside the plasma volume and can be eliminated by selecting a n(r) distribution more compatible with experiment. Experiments were carried out using gas discharge tubes ~/cm in radius with $\sim 10^{-1}$ to 10^{-3} mm Hg pressure. A one-dimensional model (with a symmetric plane layer) with concentration dependence on Decartes coordinate x was used. It is assumed that at the boundary layer ($x = \pm L$) electrons are subject to mirror reflection and that at wide Δx intervals ($L > |\Delta x| \gg D$). Adjacent to $x = \pm L$, n(x) is linear. (R.V.J.)

21441 THE REFLECTION OF VERY LONG ELECTROMAGNETIC WAVES AT AN ANISOTROPIC INHOMOGENEOUS IONOSPHERIC PLASMA. H. Volland. Thesis, Berlin, Technische Hochschule, 1963. 65p. $2.00(Gmelin, AED-DISS. 63-303). (In German)

For very long waves the ionosphere can be approximated by a number of homogeneous and parallel layers. Methods for the determination of reflection factors of plane waves in this anisotropic medium are given. Several plausible ionosphere models are discussed. (Gmelin Inst.)

21442 PLASMA UNDER THE INFLUENCE OF STATIONARY CROSSED ELECTRIC AND MAGNETIC FIELDS. Vishnuprakash Joshi. Thesis, Munich, Technische Hochschule, 1962. 46p. $2.00(Gmelin, AED-DISS. 62-675). (In German)

Construction of a crossed-field apparatus for ion acceleration is described. The ions are accelerated in a direction perpendicular to the electric field so that no arc discharge is produced. Ion velocities and temperatures are given. (Gmelin Inst.)

21443 MAGNETOHYDRODYNAMIC ROTATION OF PLASMAS. Kwadwo Ohemen Kessey. Thesis, New York, Columbia Univ., 1963. 182p.

The rotation of an incompressible plasma was analyzed for the case when it is confined in an axisymmetrical cylindrical structure impressed with radial electric and axial magnetic fields. The analyses were concerned with steady and transient, one- and two-dimensional laminar flow of a nonviscous and viscous plasma with either small or very large electrical conductivity. The one-dimensional analysis, referred to as the Zero Radial Mass Flux (ZRMF), involves the azimuthal component of velocity only. The two-dimensional analysis, called the Non-Zero Radial Mass Flux (NRMF), deals with both the azimuthal and radial components of velocity. On the basis of two physically interesting approximations, the flat disc and the long cylinder, analytical solutions were obtained for both the steady and unsteady velocity and pressure fields. Certain quantities of technological interest were determined. In particular, the radial electric current, electric power input, kinetic energy stored in the device, and the dissipative mechanisms of Joule heating and viscous dissipation were obtained for all the cases considered. The analysis of the single fluid was extended to include a multicomponent fluid. Hence the magnetohydrodynamic analogue of the well-known centrifuge was considered. (Dissertation abstr., 24: No. 9, March 1964)

21444 EXPERIMENTAL INVESTIGATION OF MICROWAVE PROPAGATION IN A PLASMA WAVEGUIDE. Robert Nichols Carlile. Thesis, Berkeley, Calif., Univ. of California, 1963. 118p.

The phase characteristics of a backward-wave pass-band mode were measured in a circular waveguide, which is coaxial with a circular isotropic plasma column. The mode was identified as an n = 1 surface wave. Zero temperature plasma waveguide theory, which predicts this mode quite accurately, shows that a simple relation exists between the lower cut-off frequency and the electron plasma frequency obtained from this relation, where the cut-off frequency is determined from a measurement of the phase characteristics, agrees well with an independent measurement of the plasma frequency using the well-known cavity perturbation method. Noise measurements on the n = 1 and the symmetric n = 0 modes indicate that the signal to noise ratio is independent of input signal power and is about 7 db for the n = 1 mode and varies from about 7 to greater than 30 db for the n = 0 mode. A simple model of the plasma is proposed that explains all the noise observations reported. A strong DC axial magnetic field was applied to the plasma and the phase characteristics of the perturbed TE_{11} empty waveguide mode were measured and are presented. In this case, the two degenerate circularly polarized modes that constitute the TE_{11} mode in an empty waveguide become non-degenerate and thus will have different phase characteristics. The results are in qualitative agreement with the theoretical work of others. It is demonstrated experimentally that as the magnetic field is reduced, at a given frequency, the propagation constants of the two modes

approach each other and finally coincide at zero magnetic field. (Dissertation abstr., 24: No. 9, March 1964)

21445 THE THEORY OF MAGNETOHYDRODYNAMIC FREE SURFACE WAVES. Levi Aldrich Cass V. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 116p.

The theory of small amplitude, planar traveling waves on a free surface for an inviscid liquid was extended to include an electrically conducting liquid in an applied (uniform) magnetic field. The equation of magnetohydrodynamics are linearized and manipulated to give a differential equation for the current density. Solution of the current equations leads in a systematic way to velocity, magnetic, electric, and pressure fields. The solutions for the free-space region above the free surface and the conducting region below the bottom (horizontal) surface are joined with the solution for the conducting liquid at the common boundaries. Finally, a dispersion relation is derived that has incorporated in it all the pertinent boundary conditions. The dispersion relation is valid for arbitrary conductivity, arbitrary depth, and arbitrary magnetic field configuration. The dispersion relation is, in its general form, extremely complicated. Results were obtained by examining special cases; for all the results that were obtained, the region below the liquid is assumed to be an insulator. (Dissertation abstr., 24: No. 9, March 1964)

21446 CYCLOTRON WAVE INSTABILITIES. Bernard Harold John Maxum. Thesis, Berkeley, Calif., Univ. of California, 1963. 178p.

Interactions of waves on electron streams or plasmas were studied for several geometric configurations of finite cross section in a finite magnetic field. The plasma was assumed to be at zero temperature. Each of the constituents of the plasma was assumed to have a monoenergetic, nonrelativistic velocity parallel to the magnetic field. It was further assumed that either macroscopic neutrality exists or static space-charge forces were negligible. For the most part the quasi-static analysis was used. For the case of two drifting streams, cyclotron waves act to give instabilities that are either convective (spatially growing) or nonconvective (time growing), depending upon whether the streams are drifting in the same or opposite directions. These instabilities, unlike the usual two-stream space-charge wave interactions, exist for physically realizable unneutralized electron streams without the requirement that the streams drift in the same direction with almost equal velocities. Amplification is predicted in three frequency bands that can be large compared with the cyclotron frequency for streams drifting in the same direction. For oppositely directed streams with equal velocities, oscillations are predicted at approximately one-half of the cyclotron frequency and were observed at the output of an experimental tube in which two concentric coaxial electron streams were allowed to interact in an evacuated drift space. The amplitude of these oscillations was approximately 55 db below that expected. (Dissertation abstr., 24: No. 9, March 1964)

21447 PLASMA ELECTRON TEMPERATURE IN A STRONG INHOMOGENEOUS ELECTRIC FIELD. Harry Marvin Cronson. Thesis, Providence, Brown Univ., 1963. 118p.

Electron temperature effects occurring when the electrons of a plasma become heated by a strong, inhomogeneous, electric field are discussed. Steady state transport equations, based on kinetic theory, which admit elevated, spatially varying, electron temperatures; density gradients; and induced electric fields were constructed for both a weakly ionized and strongly ionized gas in a strong electric field. The physical meaning of the equations is discussed. They are then applied to determine the effect of a prescribed, strong standing wave on an initially homogeneous plasma. Here two modes of behavior are distinguishable. In the low frequency case the electron temperature follows the field and the electron temperature and electron and ion density show strong spatial dependence. The induced field linking the electrons and ions is relatively strong. In the second high frequency mode the electron temperature establishes itself around some mean value with small spatial perturbations. For this case density gradients and the induced field are negligible. Using the temperature balance equation for a strongly ionized gas, the influence of inhomogeneities on Gurevich's electron temperature instability phenomenon is considered. Both mathematical and physical arguments are advanced that support the existence of this instability in the inhomogeneous case. Lastly perturbations of the standing wave caused by its interaction with the plasma were investigated. (Dissertation abstr., 24: No. 9, March 1964)

21448 MICROWAVE INVESTIGATION OF ELECTRICALLY DRIVEN SHOCK WAVES IN GASES. James Bernard Gerardo. Thesis, Urbana, Ill., Univ. of Illinois, 1963. 136p.

The application of microwave interaction with gaseous plasmas to the study of electrically driven shock waves in inert gases and gaseous plasmas is discussed. The microwave techniques used include: phase shift and resonant probe methods of measuring electron densities in the shock wave; Doppler frequency shift of a microwave signal reflected by the shock wave plasma which enables the velocity of propagation of shock waves to be measured; and radiometer measurements of the noise power radiated by the shock wave plasma in the microwave frequency range. The microwave measurements were supplemented by observations of the visible light emitted from the shocked gas and by voltage induced signals on small metallic probes placed in the path of the propagating shock waves. The investigated shock waves were in the Mach 4 to Mach 14 velocity range and were produced in neon and argon gases at pressures from 0.1 to 5 mm Hg. The shock waves were initiated by passing an intense electric discharge current through a portion of the gas filling the shock tube. It is demonstrated that the background gas through which the shock waves subsequently passed was ionized to a nonnegligible degree at the instant of the electrical discharge. It is shown that this preionization of the background gas is consistent with photoionization by photons of adequate energy from the discharge chamber of the shock tube. In particular it is shown that under the conditions of this experiment, the photoionization is consistent with ionization by x rays from the electron bombarded anode in the discharge chamber. The effect of the free electron constituent of the ionized background gas on the properties of shock waves as well as its direct effect on experimental observation techniques is discussed. In addition, the properties of the hot and highly ionized driver gas, which expands from the discharge chamber and closely follows the shock wave down the expansion chamber, is discussed. Particular emphasis is placed on the effect of the driver gas with regards to the establishment of an equilibrium state in the shocked gas. (Dissertation abstr., 24: No. 9, March 1964)

21449 ON THE NONADIABATIC MOTION OF A CHARGED PARTICLE IN AN AXISYMMETRIC MAGNETIC BARRIER. John Reece Roth. Thesis, Ithaca, N. Y., Cornell Univ., 1963. 124p.

The problem of a particle making a single reflection from, or traverse of, a magnetic barrier was approached both numerically and experimentally. In the numerical computations, the quantity $M_4 = |v \times B|^2/|B|^3$ was calculated for each point of a particle trajectory. If M_4 varied by less than 5% during a single interaction with the magnetic barrier, the particle was said to be adiabatic. Over 52,000 particle trajectories were calculated on a high-speed computer. The results were condensed to 3 graphs, which state the particle initial conditions resulting in a variation in M_4 greater than 5%. Experimental apparatus was constructed, which permitted the study of a single interaction of a beam of charged particles with a magnetic barrier. It was possible to vary the experimental parameters and observe the onset of adiabatic reflection of the ion beam. The critical values of the experimental variables were graphed as a function of the same variables used to express the computer results. It was found that the experimental points lay on the computed curves, implying that nonadiabatic particle losses become significant if M_4 varies by more than 5% during a single interaction of a particle with a magnetic barrier. The results map out the conditions under which adiabatic motion can be expected to be observed, and they also give the conditions under which particles will not be adiabatically trapped in a magnetic bottle. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21450 A NEW THEORY FOR THE THERMODYNAMIC FUNCTIONS OF A PLASMA VIA THE BINARY CORRELATION FUNCTION. Jan Rem. Thesis, Evanston, Ill., Northwestern Univ., 1963. 183p.

Based upon the ideas of Galaiko and Pargamanik (1958), a new theory is developed, which, in principle, is capable of determining the correlation function of a fully ionized, homogeneous, plasma mixture to any desired degree of accuracy by obtaining its successive approximations. Three nonlinear integro-differential equations are derived, which govern the zero'th- and first-order approximations for a homogeneous, fully ionized plasma. They are solved for the particular problems of an electron gas and a mixture whose particles interact by means of a cut-off Coulomb potential (the cut-off distance is taken the same for all particles). The binary correlation functions are determined. These functions are used to obtain the corresponding expressions for the pressure and the internal energy. The results for the electron gas and the particular case of a plasma mixture are found to agree, respectively, with those obtained earlier by different methods by Abe and Iukhnovskii. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21451 THE MOVING STRIATION OF A LOW PRESSURE NEON DISCHARGE WITH POSITIVE COLUMN. B. Saggau (Technische Hochschule, Stuttgart). p.51-5 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In a cylindrical discharge tube intermittent oscillations are produced with a frequency defined by its own capacity and a high series resistance (10^8 Ω). At this intermittent discharge the light emission and the ion densities are investigated as a function of time and position. It is shown, that the speed of preparation of the discharge from anode to cathode is generally higher than the velocity of the positive ions. A second wave of excitation, which is produced after the first, is identical with a first moving striation. (auth)

21452 AN INERT-GAS GLOW DISCHARGE WITH LOW MAINTAINING POTENTIAL. R. F. Hall and B. J. Stocker (Mullard Research Labs., Redhill, Surrey, Eng.). p.57-61 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Stable maintaining potentials, of the order of the ionization potential of the inert gas used in a glow discharge, were attained using a low work-function cold cathode. Appreciable field emission currents were obtained from this cathode surface, in vacuo, at field strengths of the order of those to be expected at the cathode of a normal glow discharge (10^3-10^4 v/cm). Both illumination and ion bombardment of the cathode appear further to lower the surface barrier to electrons. It is postulated that field emission and field-enhanced secondary emission can account for these exceptionally low maintaining potentials. (auth)

21453 THE SECOND SHEATH AT THE CATHODE OF A LOW-PRESSURE ARC DISCHARGE AND THE INTERACTION OF AN ELECTRONBEAM WITH AN INHOMOGENEOUS PLASMA. N. Warmoltz and H. Bremmer (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). p.63-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The interaction of an electron beam, modulated by the shot noise at its cathode, with a plasma with a parabolic density distribution is considered macroscopically, in connection with the oscillations occurring at some distance in front of an externally heated cathode of a low pressure arc discharge. A considerable amplification is found in the region of decreasing plasma density just beyond the maximum density, in a certain frequency range below the plasma frequency at the maximum. The finite plasma temperature is taken into account in the regions where the amplification becomes infinite in the case of a cold plasma. (auth)

21454 THEORETICAL CONCEPTION OF THE NATURE OF TUBE GLOW DISCHARGE. Jiří Kracík (Czechoslovak Technical Univ., Prague). p.75-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

The brightly shining spiraling which arises in low-pressure glow discharge in the presence of heavy negative ions only, acquires a regular form under certain conditions, rotating slowly and regularly at the same time. The origin of a single spiraling is being solved as a disturbance of the equilibrium state of the positive column, which is considered to be quasi-neutral. It appears from the equations and results, that the presence of the heavy negative ions directly involves the existence of the spiraling, its rotation being determined by the ambipolar diffusion and by the magnetic field of the discharge. Thus the regularly rotating spiraling is a special form of a low-pressure glow-discharge with heavy negative ions. (auth)

21455 POSITIVE IONS IN THE CARBON DIOXIDE GLOW DISCHARGE. P. H. Dawson and A. W. Tickner (National Research Council, Ottawa). p.79-82 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A mass spectrometer was used to observe positive ions in d-c glow discharges in CO_2. The discharges were operated at pressures of 0.1 to 0.6 torr and current densities of 0.01 to 0.1 mamp cm^{-2}. The principal ions are CO_2^+ and O_2^+ with O_2^+ becoming the main ion in both the negative glow and positive column at high current densities. $C_2O_2^+$ is also found, as well as smaller amounts of CO^+, O^+, and C^+ and traces of CO_4^+, $C_2O_3^+$, and $C_2O_4^+$. The results indicate that much of the O_2^+ in the negative glow arises at the ex-

pense of the CO_2^+ by some process other than direct charge exchange with O_2. (auth)

21456 THE EFFECT OF ACTIVE GASES ON INERT-GAS GLOW DISCHARGES. G. F. Weston (Mullard Research Labs., Redhill, Surrey, Eng.). p.83-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The effect of adding small quantities (<1%) of oxygen or nitrogen to inert-gas discharge tubes was examined. Oxygen added to a neon tube having a nickel cathode can result in a reduction of the breakdown and maintaining potentials. A comparative method of measuring γ_i, using ion gages, has shown that as oxygen diffuses into a gage with a nickel collector γ_i decreases initially, then rises to a value higher than for clean nickel, and finally decreases. This agrees with results on the work function, explained by a place exchange mechanism. This can explain the observed glow discharge characteristics. (auth)

21457 IMPEDANCE CHARACTERISTICS OF POSITIVE COLUMN. Yoshisuke Hatta (Tohoku Univ., Sendai) and Shotaro Shibata. p.89-93 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The impedance characteristics of the low pressure direct current discharge are investigated. The impedance locus on the impedance diagram is calculated as the function of the ionization collision frequency, the characteristic frequency for changing of the electron energy and Ramsauer Townsend Effect. It gives successful explanations to the experimental results that a positive column behaves purely resistive for a certain frequency. (auth)

21458 ON A METHOD OF MEASUREMENT OF COMPLEX PERMITTIVITY OF A PLASMA AT HIGH AND LOW FREQUENCIES. F. Dubus (Faculté des Sciences, Orsay, France). p.95-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

A coaxially symmetric plasma is placed between the two conductors of a coaxially symmetric condenser. The measuring electric field is then perpendicular to the axis of symmetry of the device. The capacity of the electric dipole so formed is measured with impedances bridges for frequencies below 20 MHz. The plasma investigated is the positive column of a low-pressure glow discharge. Results are qualitatively interpreted for the case $\omega \ll \nu$, with help of classical theoretical expression of plasma permittivity. (auth)

21459 MEASUREMENT OF THE IMPEDANCE OF ELECTRIC DISCHARGE AT LOW PRESSURE AND DETERMINATION OF EQUIVALENT CIRCUIT. P. Davy (Faculté des Sciences, Orsay, France). p.99-100 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

The impedance frequency characteristics of a cold-cathode glow discharge in argon over the frequency range 300 Hz–3 MHz were measured. At low frequencies, the impedance value of the discharge cathodic part agree with a theory by Van Geel. At high frequencies, results indicate that there are two delayed effects. The equivalent circuit of the glow discharge tube is determined from results. The impedance of the positive column was measured. (auth)

21460 THE DEVELOPMENT OF A PULSE-DISTURBANCE IN A D.C. DISCHARGE PLASMA. L. Pekarek (Inst. of Physics, Prague). p.133-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The early stage of the development of a small local pulse disturbance brought into the positive column of a d-c discharge is investigated. An integrodifferential equation describing the changes in ion density is derived (valid when the dimensions of the disturbance are much greater than the Debye length). An oscillatory wave response is obtained in certain conditions in which the moving striations pattern can easily be recognized. (auth)

21461 PLASMA DISTURBANCE FOLLOWING A SHORT-DURATION CURRENT PULSE. R. Feinberg and M. E. Roberts (Ferranti Ltd., Hollinwood, Lancashire, Eng.). p.137-40 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A current pulse, of a duration in the order of ten to twenty microseconds, that was superimposed on a background current in a low-pressure mercury-pool valve, was found to be followed after its end by a temporary disturbance of the structure of the background plasma. This plasma disturbance temporarily reduces the anode voltage of the valve, the plasma space voltage with respect to cathode, the electron temperature and the intensity of optical radiation from the plasma, and temporarily increases the electron and ion densities. (auth)

21462 CONSTRICTION IN THE POSITIVE COLUMN. G. A. Woolsey (Queen's Univ., Belfast). p.141-4 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Constriction, which occurs as the result of a pinch effect in very high current discharges, can also occur in glow discharges. Two forms of constricted discharge, one steady, the second mobile, obtained in an electronegative vapor (iodine), are considered in relation to the presence of negative ions. The processes primarily responsible for constriction are thought to be electron attachment to form negative ions in the first form and recombination of positive and negative ions in the second. The second form is known to occur in electropositive gases at much higher pressures, and was attributed there, by Kenty, to volume recombination of positive ions and electrons. (auth)

21463 THE CONSTRICTION OF WEAK DIFFUSE DISCHARGES BY LOW FREQUENCY AND DC RADIAL ELECTRIC FIELDS. C. Kenty (General Electric Co., Cleveland). p.145-9 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Low current diffuse discharges at fairly high pressures are very sensitive to electrostatic effects. A 0.7 ma discharge filling a 10 cm diam tube containing 50 mm Xe is constricted to 2.4 cm diam when 1200 v 60 c a-c is applied to a metal screen surrounding the tube. The constricted discharge is fairly uniformly bright over its cross section and has a rather sharp boundary. The diameter increases with discharge current and decreases with increase of gas pressure and molecular weight. The diameter is fairly independent of frequency above ~20 c, but below this value undulates in step with the frequency. The effects are explained on the basis of positive ion sheaths under conditions of mobility flow. By measuring the ion current to an annular ring at a given negative potential placed inside the glass wall and the constricted radius, the ion mobility may be calculated. Preliminary results are in sufficient agreement with the literature. (auth)

21464 RESONANCE RADIATION REFLECTION BY THE WALLS OF A DISCHARGE. M. A. Cayless (Associated Electrical Industries, Rugby, Eng.). p.151-5 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A modification of the theory of mercury rare-gas discharges is used to evaluate the effect of reflection of resonance radiation by the walls. The discharge is shown to have a strong self-regulating tendency, so that the output of resonance radiation is hardly affected until the reflectivity is quite high, that is, over 50% in the case of a fluorescent lamp. The artificial nature of the concept of an effective absorption coefficient of a discharge for its own resonance radiation is demonstrated. A value as low as 1.2% is shown to be necessary, even when the actual absorption is practically complete. (auth)

21465 NUMBER DENSITY DISTRIBUTIONS AT LOW PRESSURES. R. N. Franklin (Royal Military Coll. of Science, Shrivenham, Wiltshire, Eng.). p.157-60 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Experiments on the resonances of a low pressure high current discharge irradiated with microwaves raise the question of how the number density distribution varies across the discharge. Typical values of electron density and temperature suggest that the electron pressure may be sufficient to influence the gas number density distribution. The plane symmetric free fall discharge treated by Thompson and Harrison is extended to high values of $n_e kT_e$ and compared with the results of Steenbeck for ambipolar diffusion. Experimental measurements of the visible light output of a mercury discharge suggest where the variation of number density with current is significant. (auth)

21466 DISSOCIATION IN A HYDROGEN LOW VOLTAGE ARC. A. G. Coulter, R. C. G. Leckey, and G. S. Higginson (Queen's Univ., Belfast). p.161-4 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A simple hydrogen diode operating in the low voltage arc regime (0.5 mmHg and 2.0 amp max.) was used to determine to what extent dissociation of the gas contributes to the overall process of energy loss. The neutral atom density was obtained from measurement of Balmer Hα absorption and percentage dissociation was measured using a Wrede gage. A value of the order of 1% was obtained. The results of these experiments were correlated with thermal dissipation measurements and information obtained using a mass spectrometer. (auth)

21467 A MODEL FOR THE LOW PRESSURE DISCHARGE NEAR LIMITING CURRENT. A. Caruso and A. Cavaliere (Euratom-CNEN, Frascati, Italy). p.165-9 of "VI^e Conférence Internationale sur les Phénomènes d' Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A simplified model is given for the low pressure discharge where the dynamics of the neutral atoms are taken into account. On this basis, the spatial distribution of the potential and of the particle densities is computed for high currents, and mechanisms leading to the limitation of the current are discussed. (auth)

21468 THE SPATIAL DISTRIBUTION OF ELECTRON TEMPERATURE IN A LOW PRESSURE PLASMA IN A MAGNETIC FIELD. L. Schott (Universität, Kiel). p.171-3 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

Probe measurements in a cylindrical diffusion chamber yield the spatial distribution of electron temperature. An increase of electron temperature towards the walls at low values of magnetic field strength is observed, which qualitatively can be explained by a model conception. At high magnetic fields a radial decrease of electron temperature is found, which is due to a transversal cooling down mechanism of the electron gas by two particle collisions. (auth)

21469 THE INHOMOGENEOUS THERMAL PLASMA COLUMN. G. Ecker, W. Kroell, and O. Zoeller (Universität, Bonn.) p.175-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In German)

So far the theoretical investigations of the cylindrical collision dominated plasma column consider the current range, where constant temperature is a good approximation for all particle components. With increasing energy input this approximation breaks down. All temperatures show radial inhomogenity. Particularly important is the radial dependence of the electron temperature for the production coefficient. The thermal effects were formulated. The results of machine solution are presented. (auth)

21470 THE DETERMINATION OF IONIZATION AND ATTACHMENT COEFFICIENTS FROM MEASUREMENTS OF IONIZATION CURRENTS. J. Dutton, F. M. Harris, and F. Llewellyn-Jones (Univ. of Wales, Swansea). p.179-82 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A knowledge of ionization and electron-attachment coefficients is of importance in the study of the behavior of ionized gases, both in the laboratory and in the upper atmosphere. These coefficients cannot be measured directly and must be determined from analysis of experimental data on the growth of ionization. The influence of the experimental and computational procedure on the values of the coefficients obtained from such experimental data is discussed. It is shown, in particular, that the treatment of the initial current I_0 is of crucial significance; small errors in the determination of this quantity can, for example, lead to values of the attachment coefficient which differ widely from the mean. A procedure which gives significant mean values is developed, and recent values thus obtained for air in the range $30 < E/p < 38$ v (cm. mmHg)$^{-1}$ using this procedure are given. The values of the apparent ionization coefficient $\alpha'(\alpha' = \alpha - a$, where α is the Townsend primary ionization coefficient and a is a coefficient representing the action of radiative, three-body and dissociative attachment) obtained are in agreement with previously published values. The values of the total attachment coefficient $(a_t/p \sim 3 \times 10^{-3}$ (cm. mmHg)$^{-1}$, on the other hand, are found to be considerably smaller than those reported previously. (auth)

21471 CRITIQUE AND EXTENSION OF THE MAIER-LEIBNITZ EXPERIMENT. R. J. Fleming and G. S. Higginson (Queen's Univ., Belfast). p.183-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The classical Maier-Leibnitz experiment in helium was repeated using cylindrical and planar electrode geometries. In both cases large secondary electron currents, due to the incidence of metastable 2^3S and 2^1S helium atoms on the collector, were detected. After applying various corrections, the value of the 2^3S electron collision cross section of the helium atom, at maximum, is found to be 2.8×10^{-18} cm^2 ± 10%. The corresponding Maier-Leibnitz value is therefore too large by at least 30%. (auth)

21472 IONIZATION IN HELIUM. D. Kenneth Davies (Westinghouse Electric Corp., Pittsburgh), F. Llewellyn-Jones, and C. G. Morgan. p.187-9 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Values of the primary ionization coefficient α/p_0 of purified helium deduced from observations of the spatial dependence (I,d) of small ionization currents in uniform electric fields E over a wide range of pressure p_0 (corrected to 0°C) are presented. Over the whole range studied the similarity relation $(\alpha/p_0) = \phi(E/p_0)$ was found to be obeyed, i.e. the values of α/p_0 in purified helium are a function of E/p_0 only and do not depend upon either p_0 or d separately. These values of α/p_0 are compared with theoretical values computed from electron energy distribution functions and inelastic collision cross section data. (auth)

21473 ON THE EMISSION OF Hα RADIATION FROM SELFSUSTAINED TOWNSEND DISCHARGES IN HYDROGEN. Kaare J. Nygaard (Norges Tekniske Högskole, Trondheim, Norway). p.191-5 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In self-sustained Townsend discharges between plane parallel electrodes in hydrogen at pressures $2 < p < 35$ torr, currents $10 < I < 500$ μA and electric field/pressure ratios $65 < E/p < 250$ v/torr cm the relative intensity of the Hα line was measured by means of an interference filter and a photomultiplier tube. The Hα intensity is found to be proportional to the discharge current over the whole range of the parameter E/p. A marked pressure dependence of the line intensity may be theoretically explained by a quenching process. (auth)

21474 ABSORPTION OF PHOTONS FROM A GAS DISCHARGE. G. R. Govinda Raju, J. A. Harrison, and J. M. Meek (Univ. of Liverpool). p.197-201 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The absorption coefficient μ of photons from a Townsend discharge was measured for several gases by arranging three gaps in series. Photons produced in a discharge in the primary gap pass through the adjustable central gap where some are absorbed. Those remaining enter the detecting gap and, by photoelectric action at the cathode produce a current $I = I_0e^{-\mu d}$ from which μ is obtained. Ions and electrons formed in the discharge in the primary gap are excluded from the central section by a system of grids. The absorption coefficients obtained for nitrogen and air agree with the values obtained by earlier workers under similar discharge conditions. (auth)

21475 A MICROWAVE INVESTIGATION OF SELF-QUENCHING CYLINDRICAL DISCHARGES. Paul R. Caron (Brown Univ., Providence) and Ralph D. Kodis. p.207-11 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A theory of low pressure, self-quenching cylindrical discharges was developed on the basis of the electric field dependence of the first Townsend coefficient. The result is an integrodifferential equation of the Volterra type, whose solution is used to calculate the time variation of the resonant frequency of a microwave cavity housing the discharge. Measurements carried out at a wavelength of 3 centimeters in a TE_{011} cavity filled with either nitrogen or oxygen give experimental values of frequency shift during the quenching period which compare well with the theoretical results. The electron density and degree of ionization are also found for each discharge. (auth)

21476 IONIZATION PHENOMENA IN MERCURY VAPOUR. D. Smith and D. E. Davies (Univ. of Keele, Staffordshire, Eng.). p.213-16 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Measurements of the Townsend first ionization coefficient α for mercury vapor under uniform field conditions over a wide range of E/p_0 are presented and compared with previously obtained values. The mercury was twice vacuum distilled before being distilled into the all-glass experimental tube to form a pool which acted as the cathode. Measurements are also presented that show that for such a clean, thoroughly outgassed mercury cathode in pure mercury vapor, reproducible values of the minimum sparking potential can be obtained for different experimental tubes provided the electrode geometries are similar. The combination of the values of α/p_0 (= $f(E/p_0)$) and the sparking potentials V_s (= f(pd)) provides values of the generalized secondary ionization coefficient, ω/α, as a function of E/p_0. The expected important contribution of photons and metastable atoms to secondary emission from the cathode is evident at low values of E/p_0. (auth)

21477 IONIZATION COEFFICIENTS IN HYDROGEN, HELIUM, AND NEON. J. Fletcher and D. E. Davies (Univ. of Keele, Staffordshire, Eng.). p.217-22 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The first and second ionization coefficients were determined in hydrogen, helium, and neon from measurements of spatial growth of current between parallel plate evaporated film electrodes. Ultrahigh techniques were used to obtain a residual gas pressure of less than 10^{-10} mm Hg in a bakeable, all glass experimental tube. The gases used were highly purified, the hydrogen by absorption onto uranium and subsequent decomposition of the resulting hydride and the helium and neon by cataphoresis action. The values obtained fall below previous determinations while, although the secondary coefficient in hydrogen is found to be a monotonic function of E/p, photoelectric peaks were observed for the rare gases. An attempt was made to deduce the variation of mean electron energy with E/p over a wide range. (auth)

21478 IONIZATION STRIATIONS IN THE DISCHARGE POSITIVE COLUMN. A. V. Nedospasov and Yu. B. Ponomarenko (Academy of Sciences, USSR). p.223-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The ionization-diffusion nature of the striations in the positive column is now beyond doubt. The main characteristics of developed striations are clearly described by the quasineutral plasma and charge ambipolar diffusion. The measurements of decrement near the boundary show that the striations arise from the development of the oscillatory instability (overstability) of the equilibrium state. The instability mechanism is considered in more detail. In particular, it is shown that the stability is greatly influenced by the variations of the concentration of metastable atoms, while the presence of the external circuit feedback is not necessary. The characteristics of a stationary wave of small finite amplitude can be found near the stability boundary if the wave amplitude equals zero at the boundary. (auth)

21479 STUDY OF SOME INSTABILITIES IN A DISCHARGE IN CONTINUOUS CURRENT AT LOW PRESSURE OF RARE GAS. Jean Favalier (Société Thomson-Varian, Paris). p.229-38 of "VI^e Conférence Internationale sur les

Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

In a hot-cathode discharge tube, a grillwork-type grid is placed between the cathode and the anode, and is at the same potential as the cathode. Ionization is produced only between the grid and the anode. Xe is used in the tube at 0.09 to 1.5 torr. For the case of a continuous current, it is shown that there exist voltage fluctuations in the frequency range of 0 to 3 Mc. The characteristics (amplitude, frequency spectra, etc.) of these fluctuations are studied. In this spectrum is found a single maximum, for which the frequency depends on the $\frac{1}{2}$ power of the current. (tr-auth)

21480 HIGH VOLTAGE AND HIGH PRESSURE DISCHARGES. Leonard B. Loeb (Univ. of California, Berkeley). p.239-51 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The difference between a Townsend-like breakdown threshold and sparking threshold is carefully defined with the sparking mechanism the primary subject. Presented are the excellent contributions on the statistics and development of avalanches relative to Townsend breakdown and streamer formation; the results of photomultiplier and Lichtenberg figure techniques in streamer breakdown; Tamura's recent contribution on photoionizing radiations in point corona; Hermstein's discovery of negative ion glow corona acting as a spark inhibitor; and Miyoshi's recent complete studies on the negative point corona breakdown in air. (auth)

21481 A STUDY OF THE INTERFEROMETRIC DETERMINATION OF GAS DISCHARGE TEMPERATURES. K. R. Hearne, H. Edels, and G. Howarth (Univ. of Liverpool). p.253-9 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The sensitivity of the interferometer as a measuring instrument of temperature reduces rapidly with increasing temperature, over the range in which ionization has a negligible effect on refractive index. This effect and additional errors which are introduced by lack of discharge symmetry and non-uniform boundary conditions are discussed. An interferometric investigation of a hydrogen high pressure arc is described, and a description given of the apparatus whereby a high degree of symmetry and boundary control was obtained. Despite the good experimental control and high accuracy of fringe measurement, the arc column temperature results are not yet reproducible. Further investigations are being made. However, accurate measurements can be obtained in the outer gas boundaries, and isothermal distributions are given. These distributions clearly show the effect of electrode geometry and polarity. (auth)

21482 CURRENT INTENSITY IN AN IONIZED CANAL OF A WEAK SECTION. M. Maurice Skowronek (CNRS, Bellevue, France). p.261-3 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

The corona effect between a point (positive) and a plane—when the point is very sharp ($0 < 5 \times 10^{-5}$ cm) is studied; a little luminous canal is seen to join the point and the plane. The current density is above 10^{9} amp/cm^{2}. A condenser of 4.4 μf under 90 kv is discharged through this canal. The brightness of this discharge corresponds to the black body above 10^{4}°K. A cylindric shock wave of Mach number 12 to 15 is observed. Photographs taken with Kerr-cells shutters establish that the current (220 kamp) flows through the canal. (auth)

21483 CALCULATION OF PRESSURE VARIATION AND OF HEAT CONDUCTIVITY IN AN ARC COLUMN WITH SUPERPOSED MAGNETIC FIELD. R. Wienecke (Institut für Plasmaphysik, Garching, Ger.). p.265-7 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

If an axial magnetic field is superposed on a cylindrically symmetrical arc, the radial diffusion of charged particles is affected and the neutral particles remain unaffected. Therefore in the high temperature parts of the column, the total pressure increases until a new stationary equilibrium is established where the sum of all radial mass flows vanishes again. Since an energy transport is connected with the diffusion (heat conductivity due to transport of dissociation and ionization energy), it is also changed by the magnetic field. Using the equations for conservation of momentum for the single components, the dependence of the total pressure on the temperature with given values for the external magnetic field and pressure was calculated for hydrogen and helium. Furthermore the dependence of the heat conductivity on the same parameters was examined. (auth)

21484 MEASUREMENTS OF A STATIONARY D.C. HELIUM ARC WITH FLOW IN AN AXIAL MAGNETIC FIELD. C. Mahn, H. Ringler, R. Wienecke, and S. Witkowski (Institut für Plasmaphysik, Garching, Ger.). p.269-72 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

With the intention of studying the influence of a magnetic field on the transport coefficients perpendicular to the field lines, spectroscopic measurements were made of the radial distribution of the density and the temperature of a cylindrical d-c helium arc in an external axial magnetic field up to 15 kgauss, stabilized by an axial flow of about 10^{5} cm/sec. The arc plasma was produced by a plasma jet, the current in the arc being 200 amps. By side-on observation with a glass prism spectrograph one obtained the radial intensity distribution of the HeI (4713 Å)—and the HeII (4686 Å)—lines, from which the corresponding temperature and density distributions could be evaluated. These measurements were made for different values of the magnetic field. Under the prevailing experimental conditions one observes a pressure increase due to the magnetic field, while the temperature is not essentially influenced. The reason for this is that the current density is not yet high enough to get a minimum temperature above which the coefficient of heat transfer can be considerably reduced. With a 10 kgauss field the pressure increases from 10 to 50 mm Hg and the temperature in the axis is 3×10^{4}°K. There is also described an electromagnetic probe arrangement which makes it possible to obtain a radial profile of the plasma velocity. (auth)

21485 A.C. ARC MOVEMENT IN A TRANSVERSE MAGNETIC FIELD. J. Pratl and W. Rieder (Brown Bovery Corp., Baden, Switzerland). p.273-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In atmospheric air, the speeds of alternating current arcs were measured in homogeneous, constant transverse magnetic fields. The arc speeds were measured for arc currents $\geq$100 amp and could be linked to the values that were previously given for direct current arcs of $\leq$50 amp. On increasing the current further, the arc speed continued to rise steadily. Between brass electrodes, the arc speed increased with increased electrode spacing, whereas with copper electrodes the opposite tended to be the case. Dur-

ing a current half-wave, the maximum arc speed was attained after the current maximum. (auth)

21486 PLASMA JETS IN MAGNETIC FIELDS. V. Hermoch (Inst. of Physics of Solids, Prague) and J. Teichmann. p.275-8 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The behavior of plasma jets in a magnetic field perpendicular to the axis of the jet was examined. Experiments were performed with a short-time high-intensity electric discharge. The motion of the jets was studied by means of a streak camera. In a magnetic field the plasma jet is bent in the same direction as the discharge channel. The magnitude of the deviation is a function of the magnetic field strength, the gas pressure, and the cathode material. An analysis of the forces acting on the jet and exciting their deformation was made by means of the MHD model and the causes of jet deformation were explained in accordance with the experiments. In conclusion, the possible connection between the motion of the discharge in a magnetic field and the formation of a jet on the cathode is pointed out. (auth)

21487 MAGNETIC DEFLECTION OF HIGH-CURRENT ARCS IN AIR. A. E. Guile and H. C. Spink (Univ. of Leeds, Eng.). p.279-82 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

It was shown that whereas the forward magnetic deflection of arcs at low velocities is mainly governed by cathode-fall processes, the movement at velocities above about 50 m/sec is also affected by the arc column. While the velocity is still a function of cathode material and surface condition in this region, the velocity is restricted by the aerodynamic retarding force on the column to a value below that at which the movement of cathode emitting sites could take place. (auth)

21488 SOME OBSERVATIONS ON THE FORWARD AND RETROGRADE MOTION OF ELECTRIC ARCS IN TRANSVERSE MAGNETIC FIELDS. Ward C. Roman (Office of Aerospace Research, Wright-Patterson AFB, Ohio). p.287-94 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Experimental results are described dealing with the motion and phenomenology of electric arc discharges in transverse magnetic fields. The investigation is concerned with a discharge at sub-atmospheric pressures of argon within an annular gap between concentric cooled copper ring electrodes. The study primarily deals with the visualization of arc retrograde motion under controlled conditions, and with the measurement of the corresponding parameters. Data are presented indicating under which conditions of gas pressure, arc current, and magnetic field strength; amperian motion, stationary arc positioning, and finally reversed motion of the luminous part of the discharge may occur. Observations indicate that a force produced by part of the discharge against neutral particles in the vicinity of the discharge always acts in the Lorentz force direction, independent of the direction and speed of arc motion. (auth)

21489 THE RELATION BETWEEN IMPULSE CORONA AND BREAKDOWN. J. J. Kritzinger (Central Electricity Research Labs., Leatherhead, Eng.). p.295-9 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The pre-breakdown behavior of point-plane gaps under short risetime impulse conditions were investigated with fast photomultiplier techniques. The impulse corona was found to be a number of simultaneous light globules moving from the point towards the plane at speeds of 10^8 cm/sec. The criterion for breakdown of the gap was the return of these globules to the point, which then produced a fully conducting channel by subsequent multiple crossings. The high corona speed was shown to be produced by photoionization and by large space charge effects, from measurements in different gas mixtures and by probe measurements. (auth)

21490 THE EFFECT OF EIGEN SPACE CHARGE OF AN ELECTRON AVALANCHE ON ITS DEVELOPMENT. H. Raether (Universität, Hamburg). p.305-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The number of carriers n in an electron avalanche grows as exp (αx) as long as n is smaller than 10^6 (pressure ~ 10^2 torr, d ~ 1 cm). At higher amplification this law is no more valid since the eigen space charge influences the ionization efficiency of the electrons. The experiments in vapors (ether) and gases (N_2) show that the amplification goes on in an underexponential form for $10^6 < n < 10^8$. This can be understood by the effect of the positive ions which reduces by its space charge the ionization efficiency of the electrons. Comparison of calculation and experiment allows one to derive the diameter of the avalanche and the temperature of the electrons which agree with measurements of others, in the region of $n < 5 \times 10^6$. At higher values of n deviations are observed on account of the repulsive forces of the electrons. At $n \sim 10^9$ the growth becomes overexponential, the cathode directed streamer being started. (auth)

21491 THE DEVELOPMENT OF AN ELECTRON AVALANCHE INVESTIGATED BY MEANS OF A HIGH GAIN IMAGE INTENSIFIER. K. H. Wagner (Universität, Hamburg). p.309-11 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Image intensifiers with a light gain of 10^5 make it possible to photograph electron avalanches by means of the weak radiation emitted due to exciting electron molecule impacts. The images obtained allow one to measure drift velocities of the electrons and to derive information on their mean energy of agitation. Avalanches of sufficiently high amplification disclose a further development of the discharge entirely different from the accumulating process of secondary avalanches due to photoeffects at the cathode. After a certain delay period, during which additional radiation is observed in the space charge distorted region left by the avalanche, a kanal process starts near the anode propagates rapidly towards the cathode (velocity $v_k = 7.10^7$ cm/sec). (auth)

21492 TOWNSEND OR STREAMER BREAKDOWN? A. L. Ward (Harry Diamond Labs., Army Materiel Command, Washington, D. C.). p.313-16 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The Townsend model as modified by space charge was used in machine calculations of breakdown. A good fit to the measured current buildup and breakdown times in air near atmospheric pressure is obtained with the assumption of an ion contribution to the secondary ionization coefficient. No fit could be obtained using only a photon effect with a delay independent of overvoltage. Breakdown times ranging from 10^{-8} to 10^{-3} sec, dependent upon the voltage rise rate, were calculated for a 5 cm gap in air, in agreement

with measurements. The breakdown transition and the contraction of the discharge are discussed. (auth)

21493 FORMATIVE TIME LAGS IN A PRESSURISED SPARK GAP. D. H. J. Goodall and R. Hancox (United Kingdom Atomic Energy Authority, Culham, Berks, Eng.). p.337-42 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Measurements were made of the formative time lag in air, oxygen, and nitrogen in a uniform field gap. Gas pressures from 1 to 5 atmospheres (absolute), and electrode separations of 2 to 5 mm, were used. Time lags in the range 5 to 250 nsec were observed, using fields up to 220 kv/cm. The formative time lag was independent of the electrode separation at high overvoltages, and decreased with increasing pressure. More accurate measurements in air at atmospheric pressure showed a step in the curve of time lag as a function of voltage, occurring at a time lag which was consistent with the time required for a single avalanche to cross the gap. (auth)

21494 CONTRIBUTION TO A STUDY OF THE FORMATION OF DISRUPTIVE DISCHARGE IN GAS. J. Reinhardt, M. Goldman, J. Mazeau, and J. Bernard de Courville (CNRS, Ivry, France). p.359-60 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In France)

An attempt is made to present as a possible mechanism of the breakdown in gases the formation of a partially ionized leader, in the interelectrode space. A criterium of a plasma formation is proposed. If the plasma is considered as a conducting medium, the applied potential should be reported on the front of it, and the field increased because of the decreasing interelectrode distance and locally because of the sharp edge of plasma leader. The conditions for propagation of this plasma are outlined for different cases. These conditions lead to a process to be added to the other proposed mechanisms. (auth)

21495 THE MECHANISM OF VORTEX STABILIZATION OF THE ARC DISCHARGE. W. G. Braun (Aeronautical Research Labs., Wright-Patterson AFB, Ohio). p.365-7 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

An attempt is made to explain the mechanism of the vortex stabilization of an electric arc discharge based on experiments with synchronized magnetic perturbation of the arc column. The arc was confined by the gas flow in a cylindrical chamber. The experimental gas was nitrogen. (C.E.S.)

21496 GENERATION OF AN ALMOST FULLY IONIZED, SPECTRALLY CLEAN, HIGH DENSITY HYDROGEN PLASMA. E. Pfender (Technische Hochschule, Stuttgart). p.369-74 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Experiments are described aimed to the generation of an almost fully ionized, spectrally clean, dense hydrogen plasma by means of whirl stabilized arcs. A suitable discharge chamber was operated with currents up to 300 amp at a maximum input power of 250 kw. The arc length may be varied over a wide range (up to 30 cm). From energy balance measurements carried out with a small discharge chamber it was found that up to 85% of the input power was dissipated in the streaming hydrogen and the remaining part of about 15% was consumed by electrode losses. The radiation loss was negligible. (auth)

21497 DISTRIBUTION OF NARROW BAND SPECTRAL EMISSION IN THE OPTICAL REGION OVER A VORTEX STABILIZED ARC PLASMA. Werner Rambauske (Univ. of Dayton, Ohio). p.375-8 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A vortex stabilized plasma of the Pfender-Bez type formed by about 50 Kw d-c in nitrogen is photographed through a series of narrow bandpass interference filters with about one millisecond exposure time. This method when properly reduced permits study of the simultaneous emission per unit area of the plasma in selected wavelength regions all over the plasma. The evaluation of the photographs is done by microdensitometry. Uniformity, stability, and equilibrium conditions in this plasma are found by this method to be extremely high; wedge-shaped plasma columns indicate a steady change of the thermodynamic parameters over the length of the plasma. The method will allow precise measurements. (auth)

21498 RESEARCH ON THE ELECTRICAL AND OPTICAL PROPERTIES OF ARGON IN A STABILIZED ARC. A. E. Sheindlin and E. I. Asinovskii (Academy of Sciences, USSR). p.379-81 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Studies of electric discharges at 10,000 to 15,000°K, stabilized by gas flows or by solid walls, are reviewed. The performance of these discharges as sources of low-temperature plasma is compared with that of shock tubes. (T.F.H.)

21499 REFLEX DISCHARGE AT LOW PRESSURE IN A RADIALLY INCREASING MAGNETIC FIELD. H. Doucet (Ecole Polytechnique, Paris). p.387-8 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Comparative measurements show majoration of plasma lifetime and electron energy with radially increasing magnetic field. (auth)

21500 MEASUREMENTS ON A ROTATING PLASMA. J. G. Bannenberg, F. G. Insinger, C. E. Rasmussen, and J. Kistemaker (F.O.M. Laboratorium voor Massascheiding, Amsterdam). p.393-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A general description of the experiment, resembling the IXION-device, is given. Described are measurements of the rotating velocities: they are equal at all radii and drop from 1.5×10^{7} to 3×10^{6} cm sec^{-1} while the voltage decreases. Current distributions are obtained with internal Rogowski-loops. The rotating mass density distribution from momentum transfer to glass spheres gives values of 400 times the starting density. Microwave cut-off lasts for 1500 μsec. By using a fast ion gage the neutral density is found to increase tenfold within 500 μsec and to reach its initial value again after 3 milliseconds. (auth)

21501 IMPULSE DISCHARGES IN CROSSED ELECTRIC AND MAGNETIC FIELDS. P. B. Barber, M. L. Pilcher, D. A. Swift, and B. A. Tozer (Central Electricity Research Labs., Leatherhead, Surrey, Eng.). p.395-9 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The form of the rotating plasma produced between coaxial electrodes of 5 cm and 13.4 cm diameter, and 2.5 cm axial length was investigated using high speed optical and electrical techniques. In nitrogen, at pressures from 0.04 to 4 torr, the breakdown occurs initially as one or more

spokes. The plasma develops in the $\underline{E} \times \underline{B}$ direction by rotation of the ionized gas, and retrograde spoke formation accelerates plasma disc formation. Electrical records of voltage show plateau regions which continue after extinction of the discharge. The inadequacies of rotating plasma theories are discussed in the light of these results. (auth)

21502 X-RAY EMISSION BY ELECTRON BOMBARDMENT OF THE ANODE IN A HIGH PRESSURE GASEOUS DISCHARGE WITH PENNING CONFIGURATION. M. C. Ayphassorho and M. P. Loup (CEA, Paris). p.401-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

The evolution of the x-ray spectrum emitted by the anode in a Penning discharge is studied in order to determine the maximum energy of the electrons arriving at the anode. The existence of secondary oscillations in certain operating regions of the tube, and their effects on the x-ray spectrum, is also shown. (tr-auth)

21503 INSTABILITIES IN A REFLEX DISCHARGE. G. Briffod, M. Gregoire, and S. Gruber (CEN, Saclay, France). p.423-6 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Data are presented on the time and frequency resolution of the instability in a cold cathode reflex discharge which indicated that the instability produces intense radiation at frequencies on the order of 5 mHz. This radiation appears in bursts lasting several microseconds and of such intensity so as to appreciably increase the electron density. The plasma then relaxes, in a time that depends upon pressure and magnetic field, to its initial condition and the instability reappears. It is thought that the interaction between the high energy primary electrons and the plasma can explain this phenomena. (auth)

21504 FLUCTUATIONS AND ROTATIONS IN A PLASMA COLUMN. F. Bottiglioni, M. Fumelli, and F. Prevot (Euratom-CEA, Fontenay-aux-Roses, France). p.427-34 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

Quasi periodic fluctuations of density are detected by Langmuir probes in a plasma column in a longitudinal magnetic field. Azimuthal phase correlations prove the rotation of the plasma with an anisotropy of density. The measured frequencies, in the range 0–200 kHz, are function of radius and in good agreement with drift in $E_r \times B_z$ fields and density gradient. Phase correlations along the magnetic field over 3 meters, show the rotation of solid plasma tube (no torsion) which is in agreement with magnetohydrodynamics. The observed frequency dependence on $B_z^{\frac{1}{2}}$ can be explained by the motor effect of radial current of the discharge. (auth)

21505 LOW-FREQUENCY INSTABILITIES OF A FULLY IONIZED GAS. Francis F. Chen (Euratom-CEA, Fontenay-aux-Roses, France). p.435-9 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Low-frequency instabilities of a fully ionized plasma column rotating under a radial electric field and a longitudinal magnetic field are investigated for conditions when the centrifugal force and the ion viscosity are not negligible. It is found that instabilities caused by the centrifugal force have a slow growth rate unless ion inertia, that is, the finiteness of the ion gyroradius is taken into account. The growth rate then is large enough to be interesting. (auth)

21506 FLUCTUATIONS IN A GYRO-DOMINATED PLASMA. E. C. Lary, R. G. Meyerand, Jr., and F. Salz (United Aircraft Corp., East Hartford, Conn.). p.441-9 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The behavior of a low density plasma was studied in an annular geometry with radial magnetic and axial electric fields. In the regime of small electron gyroradius, large ion gyroradius, and large electron mean free path, the expected phenomena of axial ion acceleration with azimuthal electron drift were already shown. The influence of microscopic plasma instability, in addition to that of electron collisions, was studied theoreticaliy. The analysis indicates an increased electron mobility in the axial direction, as compared to that expected from collisions alone. Experiments show an increased mobility, or enhanced diffusion. High-frequency fluctuations in current and potential further suggest the presence of an instability. The mechanism of two-stream electrostatic instability is investigated for a gyro-dominated plasma, and a criterion for maximum stable drift is established. This criterion forms the basis of a description of the gyroplasma subject to electric fields greater than a critical value. (auth)

21507 INTERACTION OF PLASMA OSCILLATIONS WITH CONDUCTION IN A PENNING GAUGE. Frederic R. Crownfield, Jr. (William and Mary Coll., Williamsburg, Va.). p.451-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Oscillations were observed at v-h-f in a Penning Gage operating at pressures of the order of one micron of mercury in magnetic fields of about 200 oersteds. The oscillations occur only for certain values of the anode voltage, and concurrent with the oscillations anomalies are observed in the current vs voltage characteristic of the gage. This behavior clearly indicates an interaction between these oscillations and the conduction mechanisms in the gage. An interpretation of the nature of the oscillations and a discussion of their excitation are presented. The details of the interaction are not yet fully understood. (auth)

21508 RECENT STUDIES ON NON-CONTROLLED H.F. DISCHARGES BY DIFFUSION REGION. T. Consoli (CEN, Saclay, France). p.455-63 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

After a tentative classification of discharges by stationary and progressive r-f fields, a review of theoretical and experimental work on this field is given. (auth)

21509 FORMATION AND DECAY TIMES OF DIFFUSION CONTROLLED ELECTRODELESS RING DISCHARGES. Hans U. Eckert (Lockheed-California Co., Burbank, Calif.). p.465-70 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A simple method is presented for calculating the time dependence of the average electron density during formation and decay of inductive high-frequency discharges. Primary electron production and diffusion are considered to be the only competing processes and to differ only moderately from their equilibrium rates. The method makes use of steady state solutions in the transition region between free and ambipolar diffusion. Sample calculations for a discharge in hydrogen at pR = 5 indicate that the formation and decay times can roughly be subdivided into three regimes which are dominated by either free diffusion, ambipolar diffusion, or skin effect. (auth)

21510 ELECTRON IONIZATION FREQUENCY IN DEUTERIUM. W. B. Cottingham (Bell Telephone Labs., Whippany, N. J.) and S. J. Buchsbaum. p.471-2 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The ionization frequency by electrons in deuterium was measured during microwave breakdown using optical techniques for $36 \leq E_e/p \leq 200$ v/cm-torr. The ionization frequency in deuterium is only slightly larger than the previously measured ionization frequency in hydrogen and, at the lowest E_e/p, is below that deduced from Rose's measurements of the Townsend-alpha coefficient. (auth)

21511 PROGRESSION OF A UHF DISCHARGE IN RAREFIELD GAS. Jean Collomby. p.473-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

A pulse generator with a frequency of 3.2 Ge excited a Ne-filled tube at low pressure. The ionization front moves with a speed dependent on the gas pressure and the tube diameter. This speed is found experimentally to lie between 1 and 2 km/msec. An interpretation of the experimental results is given. (tr-auth)

21512 INTERFEROMETRIC STUDY OF A R.F. DISCHARGE. U. Ascoli-Bartoli and A. De Angelis (Euratom-CNEN, Frascati, Italy). p.475-7 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The time dependence of the radial configuration of the electronic and atomic densities is studied in a pulsed r-f plasma. The diagnostic used is the optical interferometry. Experimental results are given for a discharge in argon at 10 torr. (auth)

21513 GAS BREAKDOWN AT OPTICAL FREQUENCIES. R. G. Meyerand, Jr., and A. F. Haught (United Aircraft Corp., East Hartford, Conn.). p.479-90 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Electric breakdown of gases was observed at optical frequencies. Field strengths of the order of 10^7 volts per cm at a wavelength of 0.6943 microns from a pulsed ruby laser were required for the breakdown and produced electron densities up to 10^{17} electrons per cm^3. The breakdown field strength obeys a threshold criterion, indicating that it is a true cascading process. The optical field strength required for breakdown was investigated as a function of gas pressure for a number of gases. It is shown that the results obtained cannot be explained by direct electric field stripping of electrons from atoms, multiple photon absorption, or conventional microwave breakdown theory. It is believed that inverse bremsstrahlung is responsible for the observed ionization. (auth)

21514 A STUDY OF THE RF DISCHARGE IN A SINGLE-TURN COIL. B. A. Anicin and B. S. Marsicanin (Inst. of Nuclear Sciences "Boris Kidric," Belgrade). p.491-5 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

An r-f discharge at 70 w, 125 mHz was maintained in hydrogen by a single-turn coil. The distribution of light from the discharge was recorded. An attempt was made to obtain rotational symmetry by the use of screening cages. Higher order electromagnetic modes were set up in these structures, resulting in higher order symmetries of the discharge. The discharge was submitted to a transverse magnetic field and the dependence of r-f power on induction was studied. It is found that the electric field of the unscreened coil is essentially normal to the symmetry plane of the coil. The impedance of the discharge loaded coil was measured. (auth)

21515 EVIDENCE OF THE DIPOLAR RESONANCE EFFECT ON THE PERMANENT REGION OF A DISCHARGE AT HIGH FREQUENCY. J. Taillet (CEN, Saclay, France). p.497-500 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

The r-f field measurements by electron beam techniques in r-f plasmoids show that the internal r-f field is decreased or enhanced by an order of magnitude, depending upon the excited mode. This simple experiment shows that, in such dispersive media with low collision frequency, the steady state depends on the resonant behavior of the plasma in that the electron density adjusts itself to keep the resonant frequency approximately equal to the excitation frequency. (auth)

21516 HELICAL STRUCTURES IN RF PLASMAS. C. J. Ransom and H. Schlueter (Univ. of Texas, Austin). p.501-4 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

With a 30 Mc oscillator, electrodeless hydrogen discharges are created in a magnetic bottle configuration. In the azimuthal direction around the axis of the magnetic field a set of striation-like plasma arms are observed. The arms are twisted around the axis of the magnetic field and rotate around the axis, except for certain critical field strengths. The rotation frequency decreases rapidly with increasing magnetic field strength, passes through zero, and increases again. At the critical magnetic field strengths the sense of rotation is reversed. (auth)

21517 EXPERIMENTAL STUDY OF AN R.F. ARGON TORCH. M. Clement, T. Consoli, C. Gormezano, P. Ricateu, and M. Weill (CEN, Saclay, France). p.505-8 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Spectroscopic and microwave measurements on an r-f argon torch are described. The main characteristic of this torch, measured essentially by a spectroscope, is the density $N_e \simeq 10^{17}$ e/cm^3, the temperatures $10^4 < Ti = Te < 10^5$K. A 0.6 mm microwave signal was found to be cut off both at the center and at the edge of the arc. (auth)

21518 THE COMPRESSION OF THE PLASMA COLUMN BY THE H.F. ELECTRIC FIELD. K. S. Golovanivskii and A. A. Kuzovnikov (Moscow State Univ.). p.509 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Charged particles of a plasma placed in an external h-f electric field are subjected to the action of unidirectional forces having h-f quasi-potentials. The action of the h-f quasi-potential in a low temperature plasma was found from the variation of the radial distribution of the ion density and the spacial potential in the cylindrical plasma on application of the h-f field. It is shown that the plasma is pushed out of the regions of high electric field amplitude toward the regions of the weak field. (C.E.S.)

21519 THE FREQUENCY PROPERTIES OF THE H.F. QUASI-POTENTIAL IN THE LOW TEMPERATURE PLASMA. K. S. Golovanivskii and A. A. Kuzovnikov (Moscow State Univ.). p.511 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The frequency properties of the h-f quasi-potential are investigated as a function of the plasma parameters. Ex-

periments were carried out with He, Ne, and Kr low temperature plasmas to determine the upper and lower frequency limits of the h-f quasi-potential. The results agree with theoretical values and confirm the suggested mechanism of the electrostatic polarization of the plasma in the external electric field. (C.E.S.)

21520 ENERGY GAIN OF CHARGED PARTICLES AFTER REFLECTION FROM AN R.F. FIELD NEAR CYCLOTRON RESONANCE. R. B. Hall (CEN, Saclay, France). p.519-22 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

When a charged particle is reflected from an r-f field in the presence of a uniform d-c magnetic field, a considerable gain of energy can occur. Results concerning such a study of energy gain are given. It is concluded from these results that above a critical magnetic field, dependent on the electric field amplitude, an average charged particle will gain energy at each reflection from such an electromagnetic boundary. Eventually, the energy will become great enough so that the particle escapes the confining region unless there are compensating energy losses within the confined region. (auth)

21521 PARTICLES ORBIT STUDIES. T. Fessenden (CEN, Saclay, France). p.523-6 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

An approximate method of calculating particle orbits in high frequency electromagnetic and static magnetic field combinations is considered. A generalized version of the well known time-average theory is used that includes a static magnetic field which may be nonuniform. Particle orbits are found in two different field configurations and compared with solutions of the exact motion equations obtained with the aid of an analog computer. The agreement is good except in the neighborhood of the cyclotron resonance. (auth)

21522 TRANSIENT DISCHARGES ACROSS VORTEX STABILIZED ARCS. K. H. Hocker (Technische Hochschule, Stuttgart). p.527-38 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The ohmic heating of dense plasmas is investigated theoretically and by experiment. The heating of dense gas with atomic numbers larger than 4 is limited to temperature of 65–70,000°K by radiation transport. Effects of the self magnetic field are of minor importance. There is practically no disturbance due to instabilities. In hydrogen the radiation transport is not of importance. Because of this, the temperature that may be reached will approach 300,000°K, a limit that is determined by stability considerations. In any case, the temperature obtained is far below those values at which ohmic heating becomes uneffective because of the cross section diminishing with energy. (auth)

21523 THE COMPRESSION OF A PLASMA IN A HARD CORE PINCH EXPERIMENT BY SHOCK WAVES. W. Koppendorfer (Institut für Plasmaphysik, Garching, Ger.). p.545-8 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A hard-core apparatus which is a combination of a linear z-pinch and an antipinch is used to compress a plasma rapidly to a hollow cylinder. A strong preionization and a superposed axial magnetic field gives an initial state of a fully ionized plasma in the density range from 2×10^{15} up to 5×10^{15} ions per cm^{3} and a frozen-in axial magnetic field variable from 200 up to 1500 G. The measurement of the structure of the axial field during the first compression by means of magnetic probe techniques permits the study of the propagation of radial shock-waves. By altering the initial particle density and the initial axial field which define the Alfven velocity, Mach numbers in the range of 1 up to 3.5 were obtained. The velocity of the shockfront depends on the Alfven velocity and on the compression velocity in a way that one would expect from magnetohydrodynamic Hugoniot equations. The thickness of the shockfront seems to be defined by particle collisions. The comparison with discharges without preionization shows by estimating the work done on the plasma that the compression of a highly ionized plasma is much more effective than a compression without preionization. The stability of the plasma cylinder which depends mainly on the influence of the strong dynamical forces is not as good as reported from other comparable hardcore experiments. (auth)

21524 TRANSFORMATION OF POWDER INTO PLASMA BY PHOTOLYSIS. Marcel Haegi (Euratom-CNEN, Frascati, Italy). p.549-51 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963. (In French)

In order to get a plasma of a well defined initial shape, density and composition, a powder-jet of the material which is to be transformed in the plasma, is volatilized and ionized, in a time of the order of a microsecond, by means of a powerful pulse of electromagnetic radiation, the wavelengths of which are in the range between 1 and 10,000 Angström. The calculation of the time needed to transform the powder into a plasma is compared to the time-resolved spectroscopical measurements. A practical application of this method of plasma production is mentioned. (auth)

21525 BREAKDOWN IN A THETA-PINCH APPARATUS. E. Bertolini, B. Brunelli, R. Gratton, and S. E. Segre (Euratom-CNEN, Frascati, Italy). p.553-7 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

Measurements are reported on the breakdown in a theta-pinch apparatus (CARIDDI) with high induced electric field ($\mathcal{E}/p \simeq 10^{4}$ v/cm mmHg) in the presence of an initial magnetic field. An electrostatic screen was employed since previous work showed the importance of electrostatic fields. A discussion is given of some possible mechanisms for the acceleration of electrons and for their multiplication. It is concluded that wall effects are important. (auth)

21526 ELECTRON TEMPERATURE AND DENSITY IN A Θ-PINCH DISCHARGE WITH LOW TRAPPED MAGNETIC FIELD. P. Bogen and J. Schlueter (Landes Nordrhein-Westfalen e.V., Julich, Ger.). p.561-5 of "VI^{e} Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In a hydrogen plasma compressed by fast rising magnetic fields (B_{max} = 40,000 gauss, $\tau/2$ = 1.6 μsec, coil length 20 cm) soft x rays and the absolute intensity of the visible continuum were observed after the radial oscillations were damped out. Measurements were made space resolved. N_e (1.3×10^{17} cm^{-3}) is calculated from absolute intensity, T_e (140 ev) from the soft x-ray continuum transmitted through Al and Be foils, under the assumption of a Maxwellian distribution of electron velocities. The influence of line radiation could be excluded experimentally. (auth)

21527 THREE FLUID MODEL FOR A PARTIALLY IONIZED PLASMA IN Θ-PINCH DISCHARGES. D. Duechs (Institut für Plasmaphysik, Garching, Ger.). p.567-72 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A θ-pinch discharge plasma is described by a three-fluid model of electrons, ions, and neutral atoms. Cylindrical symmetry, quasi-neutrality, and ideal gases ($\gamma = 5/3$) are assumed. Ionizing, recombination, elastic and charge-exchange collisions are taken into account. Numerical calculations yield the magnetic field and also the density, radial and azimuthal velocities, and temperature for each component as functions of position and time. Calculations can be performed for different initial conditions. Because of ionization the temperatures are found to be much lower than in former calculations for a fully ionized plasma. The results show that the effect of neutrals produces only a very small plasma rotation. The calculated magnetic field agrees satisfactorily with the results of probe measurements. (auth)

21528 RADIAL- AND TIME-RESOLVED MEASUREMENTS OF THE EMISSION FROM NEUTRAL HYDROGEN IN Θ-PINCH. A. Eberhagen and M. Keilhacker (Institut für Plasmaphysik, Garching, Ger.). p.573-6 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In order to compare with theoretical calculations of Dŭchs for a partially ionized theta pinch, the emission of Hα during the beginning of the main discharge (26 kJ, 160 kHz, 40 kv, no geometrical mirror) was measured. The electron density, temperature, and magnetic field distribution in the applied preionization (radio frequency and fast discharge heating: 0.3 kJ, 500 kHz, 24 kv) entering the calculations were determined. Eight photomultipliers on the exit slit of a monochromator yield radial and temporal distribution of the radiation. The amount of impurity in the bakeable high vacuum system was slight during time of observation (up to 0.4 μs after breakdown of main discharge). Measurements were made for pressures of 0.10 and 0.15 torr and for parallel and antiparallel trapped fields (applied bias field was variable between ±6 kΓ). Just before the main discharge the electron density is distributed in a coaxial ring with a diameter of about 2/3 that of the tube and the maximum degree of ionization in this ring is close to 100%. The radial distribution of Hα-emission agrees with the referred theoretical calculations. The intensity begins at 0.10 μs after ignition of the main bank, peaks at about 0.20 μs, and has dropped to low values at 0.50 μs (first maximum compression after 0.35 μs). (auth)

21529 TIME- AND SPACE-RESOLVED MEASUREMENTS OF ELECTRON DENSITIES FROM THE CONTINUUM EMISSION OF A THETAPINCH. A. Aberhagen and M. Keilhacker (Institut für Plasmaphysik, Garching, Ger.). p.577-80 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The absolute continuum emission of a theta-pinch discharge was measured side-on. Cylindrical symmetry of the plasma column, necessary for evaluation of the radial electron density, was checked by framing-camera photographs, by magnetic probe measurements and by the distribution of the continuum intensity on the eight light pipes. The electron densities measured in the central plane of the coil agree with calculations of Dŭchs in the radial distribution as well as in the absolute amount. Electron density and magnetic field distributions were measured for trapped parallel and antiparallel magnetic fields up to 2.5 kgauss. Further measurements of the continuum emission were carried out close to the coil ends in order to check their influence on the axial density distribution. (auth)

21530 EXPERIMENTS ON BREAKDOWN PHENOMENA IN THETA-PINCH. G. Malesani (Università, Padua). p.581-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

In order to evaluate the contribution of the electric field's conservative component E_c to the formation of the ring discharge, a rheometric probe measuring the electric field, an external magnetic probe showing the annular discharge's inception and a screen apt to eliminate E_c were employed. The experimental results indicate that E_c helps remarkably the breakdown, preionizing the gas, but does not appreciably influence the discharge's subsequent behavior. (auth)

21531 AXIAL STREAMERS IN THE Z-PINCH. R. F. Churchill and F. L. Curzon (Univ. of British Columbia, Vancouver, Can.). p.589-92 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A photographic study of streamers in nitrogen, oxygen, hydrogen, argon, and helium over a common range of gas densities is described. The discharges are powered by a 5.4 kJ, 12 kv capacitor bank generating peak currents up to 200 kamp at 10^{10} amp/sec. A pressure dependence of the appearance of the streamers is established, and in certain conditions detached streamers are observed. Comparisons of measured collapse curves with those calculated from the snow-plow theory and from electric measurements indicate that the streamers do not correspond to marked non-uniformities in the discharge current distribution. (auth)

21532 SPECTROSCOPIC STUDIES ON THE THERMAL ENERGY-DENSITY IN CONFINED PLASMAS. H. Zwicker and U. Schumacher (Technische Hochschule, Hamburg). p.593-7 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The temperature and the mean particle density in the confined plasma column of a dynamic z-pinch are measured spectroscopically. The initial pressure for He and H_2 is varied between 0.3 and 11 mmHg. From these results the thermal energy density in the confined plasma is determined as a function of the initial gas pressure. It is found that there is a steep maximum for the thermal energy density. This is reached at $p_0 = 1.5$ mmHg for both gases. The physical reasons for this maximum are discussed in connection with the measured fraction of the supplied energy which is converted into thermal energy of the plasma. (auth)

21533 RUNAWAY ELECTRONS IN TOROIDAL DISCHARGES. F. Brouillard, S. I. Herlitz, and N. R. Nilsson (Uppsala Univ.). p.599-609 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A study was made of runaway electrons in a toroidal pinch discharge. A small bismuth target supported by a glass tube was used as electron detector. The x rays produced by runaway electrons hitting the target were detected by means of a scintillator and photomultiplier. The results indicate that the electrons travel several turns around the discharge tube, following the magnetic lines of force. The

strongest signals were detected with the probe oriented along the instantaneous direction of the magnetic field. No signals were observed during the first two microseconds of the discharge; this is explained by the fact that high-energy electrons cannot be confined within the tube until the azimuthal magnetic field (B_θ) produced by the pinch current is sufficiently strong. With B_z = 1000 G the signals disappeared after about 9 μsec; at this instant the symmetry of the discharge is disturbed by instabilities or oscillations. For lower B_z the signals disappeared earlier (no signals were observed with B_z = 0), which may be explained by the fact that the component of the electric field along the magnetic field becomes too small for acceleration when the ratio B_θ/B_z increases. (auth)

21534 A LINEAR HIGH-CURRENT DISCHARGE AT ATMOSPHERIC PRESSURE. Rold B. Johansson, Erick A. Smars, and Bertil E. Wilner (Royal Inst. of Tech., Stockholm). p.611-16 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A linear pulsed high-current discharge is performed in gas of atmospheric pressure. By a predischarge system the main discharge is brought to start in a narrow straight channel. The stability of this channel in different gases is studied on Kerr-cell and streak camera pictures. To study the purity, temperature, and density of the discharge a spectroscopic investigation was made. (auth)

21535 RELATION OF CONDUCTOR CONFIGURATION TO VAPORIZATION IN EXPLODING WIRES. William G. Chace and Morton A. Levine (Air Force Cambridge Research Labs., Bedford, Mass.). p.621-5 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

The manner in which the explosive phase change occurs in a wire explosion was investigated experimentally. Should this change start at the surface and proceed toward the center, then surface to center distance should be a factor controlling rate and manner of explosion. Wire systems were exploded in which only surface to center distance was allowed to vary. It was found that total time, maximum current, and rate of vaporization as measured by di/dt were all independent of surface to center distance. Thus it is postulated that the explosion occurs simultaneously throughout the wire. (auth)

21536 SHUNTING MECHANISMS IN EXPLODING WIRES AT REDUCED PRESSURES. T. Korneff, W. Chace and E. Edelson (Temple Univ., Philadelphia). p.627-31 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

It was observed that for wire explosions in air at reduced pressures a significant amount of energy is shunted around the wire during the explosion. It is shown that at pressures to 0.5 μ Hg, there is virtually total shunting of the wire within 2 μ sec after rupture. An attempt was made to determine whether the ambient atmosphere or the material ejected is the important current carrier. (C.E.S.)

21537 COLLAPSING CYLINDRICAL METALLIC FOILS. G. Schenk and J. G. Linhart (Euratom-CNEN, Frascati, Italy). p.633-9 of "VI^e Conférence Internationale sur les Phénomènes d'Ionisation dans les Gaz. Vol. II." Paris, SERMA, 1963.

A 146 kJ, 9 kv condenser bank was used to produce a z-pinch on cylindrical metallic foils. The metals used were aluminum and copper, the thickness of the foils varied between 100 and 5 μ. Thin foils were observed to explode and were transformed into luminous metallic plasma. Observations were made by means of a fast framing camera, magnetic probes, and current and voltage measurements. A simple theory is developed interpreting the experimental results. (auth)

21538 ON THE MOTION OF A MAGNETICALLY CONFINED PLASMA CYLINDER. Chong-wei Chu (Univ. of Minnesota, Minneapolis). Quart. Appl. Math., 22: 35-45 (Apr. 1964).

The stability of a linear pinch under finite axisymmetric disturbances and the motion of a magnetically confined plasma cylinder are investigated. A MHD approach is used, and the plasma is assumed inviscid, nonheat-conducting, and of finite electric conductivity. (R.E.U.)

21539 WATER-COOLED SOLENOID FOR A PLASMA. Shi T. Wu (Univ. of Colorado, Boulder). 12p. (CONF-417-28)

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

The performance of a water-cooled solenoid for plasma containment is examined analytically. (C.E.S.)

21540 SCATTERING OF ELECTROMAGNETIC RADIATION BY IONIZED GASES. Otto H. Theimer (New Mexico State Univ., University Park). 7p. (CONF-284-9)

From National Electronics Conference on Adaptive Processes, Chicago, Oct. 1963.

If a plasma is irradiated with monochromatic radiation of circular frequency ω_0 the scattered radiation has a spectrum with intensity distribution $I(\theta,\omega_0 \pm \omega)$ depending on the scattered frequency $(\omega_0 \pm \omega)$, the scattering angle 2θ, and the incident wavelength $\lambda_0 = 2\pi c/\omega_0$. A theory is outlined that relates the observable scattering intensity $I(\theta,\omega_0 \pm \omega)$ to such interrelated plasma parameters as the density and temperature of electrons and ions, the plasma frequency and Debye shielding length, the radial distribution function of the Debye-clouds, the mean free path of electrons, and the spectrum of plasma oscillations. The practical possibilities of scattering as a tool for studying the ionosphere, and the properties of laboratory plasmas are briefly discussed. (auth)

21541 THE HOSE INSTABILITY OF A FINITE, PINCHED, RELATIVISTIC, ELECTRON BEAM PENETRATING AN INFINITE, FIELD-FREE, TEMPERATURE PLASMA. Howard Chang (Office of Naval Research, Washington, D. C.). 32p. (CONF-417-22)

From American Physical Society Meeting, Pasadena, Calif., Dec. 1963.

The hose instability of a uniform, cylindrical electron beam pinched by its self-magnetic field and penetrating an infinite, field-free, temperate plasma is analyzed. The tenuous electron beam is infinitely long and is streaming through the stationary, dense, uniform plasma at a nearly constant, relativistic velocity. The beam is assumed to be an incompressible fluid, whose behavior is adequately described by the equations of magnetohydrodynamics. The electromagnetic influence of the plasma is accounted for crudely by a complex, scalar conductivity, whose phase is crucial in determining the stability of the beam-plasma system when subjected to infinitesimal perturbations of the form $q_1(r,\theta,z,t) = \tilde{q}_{11}(r)\exp i[\omega t - kz - \theta]$. For simplicity the discussion is confined to the long-wavelength region, when $kr_0 \ll 1$, and to the low-frequency region, when $\omega \ll kv_0$, $|\omega - kv_0| \ll \omega_B$ and $|\omega_2/\omega_p^2 + \omega_{pb}^2| \ll 1$. By using the jump-conditions of magnetohydrodynamics, Maxwell's equations, and a normal mode analysis, the dispersion equation $(\omega - kv_0)^2 = \omega_B^2\,[1 - i\pi J_1(ik_0r_0)H_1^1(ik_0r_0)]$ is obtained, and its solution discussed. Strange to say, the

identical dispersion equation is obtained using other entirely different but reasonable models of the beam-plasma system, of greater sophistication than the simple, macroscopic model used here. (auth)

21542 IMPROVEMENTS IN THE GENERATION OF EXTREMELY HIGH TEMPERATURE, PARTICULARLY FOR INITIATING NUCLEAR FUSION REACTIONS. Hannes Olof Gosta Alfven. British Patent 955,268. Apr. 15, 1964. Priority date Oct. 14, 1959, Sweden.

A method and an apparatus are designed for the generation of temperatures above 10^6°K in order to initiate thermonuclear reactions. The stability of the plasma ring that is formed in the toroidal apparatus is increased by a transition layer of gas around the ring and by a magnetic field which reduces the heat conduction through the transition layer. (D.L.C.)

Shielding

21543 (BMI-1384) SHIELDING STUDIES ON SALT SLABS, GADOLINIUM, AND WATER. Raymond W. Klingensmith, Harold M. Epstein, and Joel W. Chastain (Battelle Memorial Inst., Columbus, Ohio). Oct. 7, 1959. Contract W-7405-eng-92. 40p.

A lid-tank shielding facility, similar to the one in operation at Oak Ridge, has been constructed and is in operation at Battelle. This facility was described in BMI-1291. The fast-neutron and gamma dose rates and thermal-neutron fluxes were mapped in a symmetry plane of the shielding tank. Fast-neutron and gamma dose rates were measured behind a series of shielding plugs along a line in the water perpendicular to the fission-plate center. The plug materials included aluminum, iron, lead, titanium, and gadolinium. In order to use small-diameter plugs the effective diameter of the fission plate was reduced for these experiments by placing an iris between the thermal column and the fission plate. The purpose of the test was to determine the removal cross section of gadolinium by comparison with other materials, using a small amount of gadolinium. The removal cross section for gadolinium is about the same as for lead. Experiments were conducted on ordinary and enriched LiH slabs 4 to 32 in. thick. Fast-neutron and gamma dose rates in addition to thermal-neutron fluxes were measured on the water center line behind the slabs. (auth)

21544 (BRL-Memo-1223) GRATIS—A MONTE CARLO COMPUTER PROGRAM FOR CALCULATING TRANSMISSION INFORMATION FOR SECONDARY GAMMA RADIATION. Alfred J. Budka (Ballistic Research Labs., Aberdeen Proving Ground, Md.). Oct. 1963. 73p.

The program GRATIS, designed to calculate gamma transmission information for primary and secondary radiation, is described. A plane, stratified slab of finite thickness and infinite lateral dimensions, consisting of eight slab layers, is considered. Calculations can be made for neutron-induced gamma rays distributed in a slab, a plane isotropic gamma source located outside a slab, a combination of the two preceding cases, monodirectional gamma beams, and bremsstrahlung originating within the slab. The theory is presented, together with flow charts. Results obtained with the program are compared with other results. (auth)

21545 (HW-73381(Suppl.1)) TWO CROSS SECTION LIBRARIES FOR USE WITH MAC SHIELDING CODE. J. Greenborg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT(45-1)-1350. 118p.

Two tabulations of cross sections and group constants for 77 elements and seven isotopes are presented in format arranged for direct input to MAC code problems. The absorption, elastic scattering, and inelastic scattering neutron cross sections are given in 15 and 31 group energy-lethargy structures. The additional group constants are common to both neutron libraries and include: gamma mass attenuation coefficients (7 group), energy dependent removal cross sections (18 group), neutron and gamma flux to dose conversion factors, Taylor buildup factors, and the gamma produced per neutron capture per nuclide. The methods used to calculate and estimate the group averaged neutron cross sections and constants are discussed. (auth)

21546 (NP-13805) DOSE MEASUREMENTS FOR NEUTRON STREAMING IN DUCTS. Technical Report R-282. D. R. Doty (Naval Civil Engineering Lab., Port Hueneme, Calif.). Mar. 26, 1964. 38p.

A facility for investigating neutron shielding is described, and some preliminary findings on the streaming of neutrons in ducts of protective shelters are presented. The experimental results are compared to a simplified theoretical treatment using the albedo approach. Dose measurements were obtained in a 3 × 3-ft concrete duct for thermal, 2.5-Mev, and 14.7-Mev neutrons using a 12-in. spherical energy-independent dosimeter. In the second leg, for all energies, the dose was found to have a higher drop-off than the theory predicted. Reasons for the discrepancy are examined, and a comparison of effective albedos is made for various energies. (auth)

21547 SHIELD FOR IONIZING RADIATIONS. Jan Viteslav Weinberger and August Guido Luisada (to Gentex Corp.). British Patent 954,593. Apr. 8, 1964. Filed Jan. 16, 1962.

A radiation shield is described which is flexible and adaptable for use in garments. The shield comprises a base layer of heat-resistant cloth and a lead amalgam layer secured to the base layer. Several embodiments of the shield and methods for making the shield are described. (D.L.C.)

21548 FLEXIBLE SHIELD FOR IONIZING RADIATIONS. Jan Viteslav Weinberger (to Gentex Corp.). British Patent 954,594. Apr. 8, 1964. Filed June 12, 1962.

A radiation shield is described which is inherently flexible and can be molded. The shield comprises 98.5% lead, 1% silicone rubber, and 0.5% fiber flock. The shield is made by mixing lead powder with silicone rubber and fiber flock, adding a curing agent (benzoyl peroxide), depositing the mixture on a sheet of vinylidene chloride copolymer, thinning the mixture with 5% toluene, molding the mixture with a Teflon-coated blade, and curing the molded mixture. The resulting article or layer may be secured to a fabric or sandwiched between fabric layers. (D.L.C.)

REACTOR TECHNOLOGY

General

21549 (CONF-187-111) PRESSURE PULSES IN RAPID TRANSIENT BOILING. R. W. Wright (Thompson Ramo Wooldridge Inc. TRW Space Technology Labs., Redondo Beach, Calif.). July 31, 1963. Contract AT-(04-3)-372. 19p.

From the American Nuclear Society Meeting, New York, Nov. 1963.

The multi-thousand psi pressure pulses that occurred in the BORAX-I and SPERT-I destructive power excursions are discussed, and some possible mechanisms for the production of these pulses are discussed. An experimental investigation of pressure pulse generation by purely thermal means was conducted using a model of the unmolten core geometry of BORAX-I. A current pulse of ~5,000 amp was used to increase the heated element temperature 700°C in 150 μsec; this rate of temperature rise exceeds that in the BORAX-I transient by a factor of >10. Oscillographs were made of both the prompt and delayed pressure pulses. A tentative model of the large pressure pulses occurring in the BORAX-I and SPERT-I transients is proposed in which the core surface melts while being insulated by a vapor blanket, and a delayed 150-psi water-hammer impact pressure pulse disperses the molten aluminum fuel plates to produce the delayed destructive pressure pulse by thermal means. (D.L.C.)

21550 (EUR-1624.e) STATISTICAL STUDY OF THE EFFECTS OF MEASUREMENT ERRORS ON THE EXTRAPOLATED RADIUS AND HEIGHT CALCULATION FOR A CYLINDRICAL REACTOR. M. Cocchi and G. Di Cola (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy and European Atomic Energy Community. European Scientific Data Processing Center, Ispra, Italy). 1964. 11p.

A statistical and numerical procedure used to evaluate the magnitude of the error in the size of the extrapolated radius and height of a cylindrical reactor is outlined. Monte Carlo Methods were chosen because of the complexity of the formulas. Random uncorrelated errors were considered to exist simultaneously in the placing of detectors and in flux measurements. (R.E.U.)

21551 (GEMP-283) CROSS SECTIONS FOR REACTOR ANALYSIS. Janet M. Brunner and William B. Henderson (General Electric Co. Advanced Technology Services, Cincinnati). Mar. 18, 1964. Contract AT(40-1)-2847. 105p.

A listing of the data on the revised tape is presented. The nuclear data are a reproduction of the computer printout. Other nuclear data (spectra, energy, absorption cross section of some poisons and absorption and fission cross sections of selected fuel materials) were transcribed from the tape listing to provide a more compact format or to allow easier comparison of absorbers and fuels. (auth)

21552 (NAA-SR-Memo-7545) HIGH VACUUM AND FLASH DISTILLATION FOR RECOVERY AND CHARACTERIZATION OF HIGH BOILER. Joseph D. Perret, Jr. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 1, 1963. Contract AT (11-1)-Gen-8. 45p.

Vacuum Flash Distillation (VFD) is an operable technique to recover and recycle a major portion of the High Boiler (HB) fraction now discharged to waste. It thus can provide a simple and economic coolant management process to remove the relatively nonvolatile HB fraction and particulate matter by distillation and still maintain total HB at the 30 to 35% level. Experimental results agree with calculated values, proving the validity of the vapor pressure data and the flash calculation methods used. Pyrolytic Capsule Fouling Test (PCFT) values of distillate samples were as low as those of glass-distilled terphenyls. Batch differential distillation and batch rectification under vacuum conditions have shown that OMRE Core II and Core IIIA HB are 80+% volatile under conditions of 2 mm Hg Abs. and 800°F terminal temperature. High vacuum distillation (HVD) does not appear economically competitive with VFD as a coolant management system to maintain a 30 to 35% HB coolant, but may be useful to recover residual Distillable High Boiler (DHB) remaining in the bottoms from a VFD operation. A two-step distillation operation may be the most economical method of operation to maintain a coolant containing 50 to 60% DHB. No process difficulties are indicated if a bottoms temperature of 825°F is not exceeded. Core II HB and Core IIIA HB had different true boiling point curves. Maximum resolution of individual components and reproducibility were not established, hence no conclusions as to the utility of using True Boiling Point (TBP) curves as a method of characterization could be made. Molecular weight determinations on Core II HB distillate fractions gave unexpectedly low values, which disagree with present concepts of the composition of HB. 86% by weight of this HB has a molecular weight equal to or less than heptaphenyl. (auth)

21553 (NAA-SR-Memo-7771) DETECTION OF ADSORBANT SATURATION BY RADIOISOTOPIC ANALYSIS. R. J. Sullivan and R. B. Cassidy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 9, 1962. Contract AT(11-1)-Gen-8. 26p.

The accepted method of detection of adsorbant saturation by pyrolytic capsule fouling test (PCFT) is not suitable for use with the present OMRE coolant since the influent to the adsorber column already exhibits a PCFT value below detectable limits. Recent operation of the adsorber system during reactor operation indicates that radioisotopic analysis (primarily for ^{24}Na and ^{56}Mn) can be used to detect saturation. (auth)

21554 (NAA-SR-Memo-8061) DESCRIPTION OF POOL BOILER. G. E. Turney (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 26, 1962. Contract AT(11-1)-Gen-8. 9p.

A pool boiler system was constructed for the purpose of evaluating the effect of additives on the critical heat flux of polyphenyl coolants in saturated pool boiling. A checkout of the pool boiler operation was completed, using distilled water as the coolant. The test data obtained from the checkout, along with a description and procedure for operation of the pool boiler assembly, are presented. (auth)

21555 (NAA-SR-Memo-9429) PREDICTION AND CONTROL OF LEAKAGE THROUGH CRACKS AND CAPILLARIES IN REINFORCED CONCRETE BUILDINGS USED TO HOUSE REACTORS. C. T. Nelson, A. S. Gibson, and R. L. Koontz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 6, 1964. Contract AT-11-1-GEN-8. 36p.

The effects of cracks in concrete on the leakage rate of

reactor buildings are described, along with theoretical and experimental causes of cracking. Experimental results from stressing concrete show that properly specified and prepared concrete will resist substantial tensile stresses, thus reducing cracking below that predicted by a semi-empirical application of elastic theory. The analysis demonstrates that properly designed and constructed reinforced concrete building structures can be used to house reactors. These structures can be constructed to leak less than 3 volume percent per day at 14 inches of water pressure when unpainted. With properly prepared and painted surfaces, they can be constructed to leak less than 0.1 percent per day at 14 inches water pressure. With a high bridging type of epoxy paint, the leakage characteristics will be excellent over the entire life of the reactor plant. (auth)

21556 (NAA-SR-Memo-9431) SRE CORE III FUEL ELEMENTS THERMAL ANALYSIS. F. Bergonzoli (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 27, 1964. Contract AT(11-1)-Gen-8. 18p.

The initial 30-Mw SRE Core III loading will contain a total of 33 fuel elements. Of these, the central 7 fuel elements are test elements and the remaining 26 are driver elements; 4 of the 7 test elements are designated as standard test elements. These elements are identical to the driver elements with the exception of the active fuel length. The remaining 3 test elements are designated as special test elements and incorporate fuel rods of smaller diameter and increased enrichment to obtain higher burnup rates, greater specific power, and higher fuel temperatures. Geometry design data for the various elements considered in the analysis was obtained from Dwg. No. 7602-918008. Inlet coolant temperature was specified at 650°F, the mixed-mean coolant outlet temperature for the core at 1200°F (±15°F), the maximum average temperature on the cladding at 1275°F, and the maximum fuel temperature in the range of 2000 to 2100°F. The thermal performance of the fuel elements was analyzed with the SORTD code and the Heating code. The results of the analysis are presented in tabular form. Axial temperature profiles are also presented for representative fuel elements. The core outlet coolant mixed-mean temperature was found to be 1185°F. For the special test, standard test, and highest powered driver elements the coolant outlet temperature is limited to values below 1200°F because of the specified maximum value of cladding temperature. For the remaining elements the coolant outlet temperature is 1200°F. Maximum fuel temperatures are at values less than 2000°F with the exception of the special test elements. These have maximum fuel temperatures in the range of 2000 to 2100°F. Recently, the "highest powered driver element" was redesignated as "standard test element" because of the high power level associated with this fuel element position. (auth)

21557 (NAA-SR-Memo-9444) A MULTI-CHANNEL, TWO-DIMENSIONAL, TWO-PHASE FLOW MODEL AND IBM 7090 CODE. D. E. Schramm and R. F. Berland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 31, 1963. Contract AT(11-1)-Gen-8. 173p.

A multi-channel, two-dimensional, two-phase flow model and IBM 7090 code is presented. It is designed to compute the axial and radial coolant density and quality profiles, the axial pressure profile and the weight flow distribution for an open matrix flow, boiling water reactor. The code is demonstrated to be reasonably accurate for core inlet subcooling of 0 to 65°F, core pressure of 1000 to 1225 psia, coolant mass flux of (0.5 to 4) $\times 10^6$ lb/hr-ft^2, mixed mean coolant exit quality of 0 to 25%, and average core heat flux of (0.1 to 1.6) $\times 10^6$ Btu/hr-ft^2. (auth)

21558 REACTOR MATERIALS — PROPERTIES, PROBLEMS AND DEVELOPMENT (REPORT ON THE DISCUSSION MEETING OF DGM AND DAtF STUTTGART). S. Steeb. Atomwirtschaft, 9: 116(Mar. 1964). (In German)

Reports presented at the Discussion Session on Reactor Materials of the German Society of Metallography and the German Atomforum in Stuttgart, December 9 and 10, 1963, are summarized. (M.C.G.)

21559 APPLICATION OF OPTIMUM CONTROL TO NUCLEAR REACTOR START-UP. C. N. Shen and F. G. Haag (Rensselaer Polytechnic Inst., Troy, N. Y.). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 1-9(Apr. 1964).

A simplified form of the reactor kinetics equations is developed that is suitable for application of optimization techniques. The mechanization of the simplified reactor kinetics equations uses instruments already developed. Optimization techniques are applied to a desired startup program of constant period followed by operation at constant power. The optimum controller that results is relatively simple, requiring two amplifiers with time varying gains. Numerical results are presented. (auth)

21560 TRIDIMENSIONAL THEORY OF HETEROGENEOUS REACTORS. J. Ligou (Groupement Atomique Alsacienne Atlantique, [France]) and C. Mignot. Nucl. Sci. Eng., 19: 58-73(May 1964).

An extension of Galanin's heterogeneous theory to the tridimensional problems usually met in studies of small reactors is presented. This method is also applicable to bidimensional problems. Here also, it brings in several improvements compared with the parent theory, especially concerning the radial reflector, which can here be of finite dimensions. Significant numerical examples are given. The codes used for the IBM-7090 computer lead to times of calculation that are reasonable for small reactors. They may also be used for much bigger reactors provided that they are used for bidimensional problems only. (auth)

Auxiliaries and Components

Refer also to abstracts 20192, 20193, 20194, and 20464.

21561 (APEX-603(Del.)) STATIC CONTROL CHARACTERISTICS OF FAST REACTORS. A. W. Culp, Jr., E. M. Page, and J. W. Stephenson, Jr. (Astra. Inc., [Raleigh, N. C.]). Oct. 15, 1959. For General Electric Co., Flight Propulsion Lab. Dept., Cincinnati. Contracts AF33(600)-38062 and AT(11-1)-171. Subcontract CPFF AT-126, EWA-3. 158p.

The static control analysis of two shaft-through-fast reactors (A-132-A and A-133-A systems) for possible use in the open cycle ANP program. The work consists of an evaluation of the critical masses of the systems including shield effects, determination of the control requirements of each system for an extended mission application, and investigation of the effects of different control systems. The critical masses of the systems range between 350 to 550 lbs of plutonium and 550 to 700 lbs of uranium. The

control requirements for a thousand hour mission at full power ranged from 4.5 to 6.0 per cent in reactivity. These requirements include startup reactivity requirements (bringing the system to temperature) and operating requirements. The operating requirements amount to approximately two per cent in reactivity; this includes fission product poisoning, fuel depletion due to burnup, and the positive effect of conversion of thorium to uranium-233. A number of proposed control systems appear to be more than capable of meeting the control requirements of these systems. One of the most effective systems consists of a sliding absorber sleeve between the shaft and the core with a moderating plug inside the shaft: a neutron trap. One such system permitted a control of 14.7 percent in reactivity (Δk). Three poison materials were investigated for use in these systems; europium, gadolinium, and boron-10. Of the three materials, europium appeared to be most effective, followed by boron-10. An analysis of the effect of Doppler broadening is also presented for these systems. Because of the extremely high operating temperatures, it was found that this effect was negligible compared to expansion effects. (auth)

21562 (CEA-R-2401) TABLEAUX DE CONTROLE DES RADIATIONS AUPRES DES PILES. (Control Panel for Radiation Around Reactors). Pierre Candes and Alain Barthoux (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Mar. 1964. 18p.

Radiation control around French reactors is discussed. Radiological measurements and alarm signals are displayed on a central control panel. The detectors for measuring external radiation and the atmospheric contamination are described, particularly a device for simultaneous measurement of contamination by dusts and gases. The alarm system and recording of measurements are also discussed. A simplified system that would provide data that is more useful is proposed. (D.C.W.)

21563 (GEAP-4483) THE FEASIBILITY OF USING IN-CORE ION CHAMBERS TO COVER THE COMPLETE REACTOR NEUTRON FLUX RANGE FROM STARTUP TO FULL POWER. IN-CORE INSTRUMENTATION DEVELOPMENT PROGRAM. Quarterly Progress Report, September–December 1963. R. A. DuBridge (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 1964. Contract AT(04-3)-189. 38p.

The effects of gamma radiation on neutron counting with in-core ion chambers and the range of neutron flux measurable in the RMS voltage mode are discussed. An example of ranges covered by a single detector is 5×10^6 to 5×10^{13} nv or 7 decades. This is possible with the short, fully-enriched ion chamber and in a gamma field of 5×10^5 r/hr. Gamma noise was found to spread the pulse spectrum. Results of experiments are presented in graphs and tables. (M.C.G.)

21564 (GEMP-81) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 81. (General Electric Co. Advanced Technology Services, Cincinnati). Mar. 31, 1964. Contract AT(40-1)-2847. 25p.

Testing of beryllia dielectric specimens to 2000°C for use in probe-type capacitance temperature sensors is reported. Lucalox- and alumina-insulated vacuum seals were tested for fission counter application to 816°C and for d-c ionization chamber application to 538°C. The completion of two gamma-compensated a-c ionization chambers and testing to 538°C in a simulated 400-cps control system is reported. Phase-sensitive circuits for use with an a-c ionization chamber in a fail-safe shutdown channel were investigated. The use of anodized coatings to stop low-energy secondary electrons was investigated to improve the performance of charged-fragment neutron detectors. Neutron detection, using internal conversion electrons associated with the prompt gamma emission following thermal-neutron capture in gadolinium and cadmium, was also studied. (R.E.U.)

21565 (IDO-16812) THE DESIGN OF A DYNAMIC CORROSION AND CHEMICAL CONTROL TEST LOOP AND PRELIMINARY OUT-OF-PILE TEST RESULTS. William F. Zelezny, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 12, 1963. Contract AT(10-1)-205. 90p.

A project having the objective of developing and demonstrating in actual operation a system for the chemical control of nuclear reactors has been carried to partial completion and now is temporarily discontinued because of interruption of funds. The design developed by this project embodies a circulating loop in the ETR, replacing one of the conventional mechanical control rods. Control of the reactor is to be effected by varying the concentration of a boric acid solution circulating through the loop. A second objective of the project is the performance of long-term corrosion tests on boric acid-aluminum alloy combinations. At the time of interruption the design was complete and 80% of the necessary components had been purchased. These components are being held in readiness, pending resumption of the project. A description is given of the overall loop design and the means by which this design was developed. These include critical facility measurements, analog computer calculations, hydraulic and heat transfer computations, and the construction and operation of an out-of-pile mock-up loop to determine the dynamic characteristics of the loop. (auth)

21566 (KR-64(Sect.XXIX)) BEAM EXTRACTION. A. F. Andresen (Norway. Institutt for Atomenergi, Kjeller). 11p.

A review is given of the various types of neutron beams (as regards permissible spectral interval, gamma contamination, etc.) in demand by users of reactor beam holes. A configuration for a reactor with optimum beam-experimentation facilities is suggested. (T.F.H.)

21567 (NAA-SR-Memo-7485) STRESS ANALYSIS OF SCTI MIXING TEES. Douglas Logan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 22, 1962. Contract AT(11-1)-Gen-8. 37p.

A specially designed tee, which is verified by stress analysis to be operable under the design conditions of the SCTI test installation, is shown. The main line sodium flow is changed from primary sodium flow at 1300°F to secondary sodium flow at 700°F. This is done at such a rate as to cause the downstream temperature to change 35°F/sec. There are 25 of these cycles. Startup causes a temperature change from ambient to 350°F on both lines at a rate of 100°F/hr. There are 5 of these cycles. The main line flow temperature is changed from 1200 to 1300°F in 9 seconds. There are 25 of these cycles. From the hold temperature of 350°F each line is raised at the rate of 100°F/hr. The secondary line is raised to 700°F and the main line to 1200°F. There are 300 of these cycles. At any temperature the mainline flow temperature drops 110°F in 7.5 minutes. There are 7000 of these cycles. Primary sodium at 1300°F mixes with secondary sodium at 1100°F to give a main line flow temperature of 1200°F. There are 25 of these cycles. The design pressure is 100 psi. (auth)

21568 (NAA-SR-Memo-8079) FUEL CHANNEL VARIABLE ORIFICE DESIGN. Frank R. Beyer (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 3, 1963. Contract AT(11-1)-Gen-8. 18p.

A design analysis of a variable adjustable orifice that can be used on all fuel channels is presented. With an adjustment range of $\frac{1}{4}$ turn the flow can be controlled over the range 9.9 to 36.9 lb/sec with a constant sensitivity of 5.85°F/deg. rot. for $\Delta T = 400°F$. Temperature sensitivity can be reduced by increasing the adjustment range; a rang of $\frac{3}{8}$ turn will reduce the sensitivity to less than 4°F per degree rotation. The orifice contraction coefficient must be determined experimentally. Leakage flow through the annulus between the process channel and the orifice extension tube was taken into account. A $\frac{1}{32}$ inch wide annular clearance is the maximum that can be tolerated to maintain control of the flow. (auth)

21569 (NAA-SR-Memo-8121) FABRICATION OF HEXAGONAL APM PROCESS TUBES FOR ORGANIC REACTOR APPLICATION. E. C. Supan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 11, 1963. Contract AT(11-1)-Gen-8. 18p.

The feasibility of extruding hexagonal shaped APM alloy process tubes in minimum lengths of 111 inches was demonstrated. These tubes had an internal distance across parallel flats of 4.300 inches and a 0.162 inch wall. The design was selected for fabrication of a test loop fuel element for the EOCR. A total of ten process tubes were extruded in APM alloys XAP001 and SAP 930. Severe surface galling problems were encountered in the extrusion process. This was nearly eliminated by increasing the internal corner radii of the tube and developing an improved technique for extrusion lubrication. Dimensional inspection of the process tubes revealed that the specified tolerances were not met. This is partly attributed to misalignment of tooling during extrusion. Improved dimensions could be expected in the extrusion of production quantities of process tubes, but it is unlikely that they would be within the small tolerances specified here. It is recommended that dimensional tolerances be increased for any future hexagonal process tube extrusions. It is also recommended that these tubes be further evaluated by mechanical testing and metallographic examination. (auth)

21570 (NAA-SR-Memo-8217) THE LARGE COMPONENT TEST LOOP—DESCRIPTION AND OPERATING CAPABILITIES. R. W. Atz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 18, 1963. Contract AT(11-1)-Gen-8. 16p.

The Large Component Test Loop is a facility for ASCR providing experimental capacity for subjecting large components, such as moderator assemblies and control rods, to thermal gradients and transients at varying rates of sodium flow to simulate reactor operating conditions. Two separate loops are used for heating and cooling the sodium as the testing is performed. The 3-inch pump loop, modified to operate at 1200°F, was operated at a flow of 130 gpm and a head of 25 feet. The 6-inch pump loop, limited to 1000°F operation by materials of construction, was operated at a flow of 2000 gpm and head of 65 feet. The rest of the facility has operated satisfactorily at 1200°F. (auth)

21571 (NAA-SR-Memo-9003) SRE SYSTEMS AND COMPONENTS EXPERIENCE. CORE II. E. N. Pearson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [Nov. 15, 1963]. Contract AT(11-1)-Gen-8. 31p. (CONF-258-2)

From Sodium Components Development Program Information Meeting, Palo Alto, Calif., Aug. 1963.

The design and performance of SRE Core II fuel elements, moderator cans, hot traps, cold traps, control elements, pumps, main primary heat exchanger, valves and sodium piping, and instrumentation are discussed. (R.E.U.)

21572 (NAA-SR-Memo-9253) PRELIMINARY DESIGN OF SRE-PEP CORE III VARIABLE ORIFICE. R. C. Noyes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 21, 1963. Contract AT(11-1)-Gen-8. 20p.

A single, wide-range variable orifice design is developed, which provides a maximum orifice flow area of 2.0 $in.^2$ and a minimum orifice flow area of 0.2 $in.^2$ The design is based on an overall operating core ΔP of 4.0 psi and provides for a sodium flow range of 2.45 to 10.0 lb/sec. Bypass leakage around the orifice is analyzed and accounted for in the design. It is shown that the use of piston rings is not necesary to reduce this leakage. The orifice plug profile is calculated for constant temperature sensitivity; the maximum average sensitivity being 451°F/in. for a 1.5 in. plug length. Fuel channel pressure drop is recalculated for both special and standard elements using the latest proposed designs. Maximum ΔP including wide open variable orifice is 3.6 psi. (auth)

21573 (NYO-10475) AUTOMATIC FLOW-BALANCING DEVICE FOR BOILING WATER REACTORS. Final Report. Report No. 350. R. L. Mela, R. Moissis, D. A. Gall, E. F. Doyle, and N. A. Radovcich (Dynatech Corp., Cambridge, Mass.). Dec. 17, 1962. Contract AT(30-1)-2907. 105p.

A description is given of the research on a device to control the exit steam quality in the individual fuel element assemblies of boiling water reactors. A proof-of-principle device has been constructed and successfully operated using an air-water mock-up of a boiling water reactor flow channel. The basic theoretical and experimental work in two-phase fluid flow in support of the design was also conducted. (auth)

21574 PHYSICAL AND TECHNOLOGICAL PROBLEMS OF CONTROL RODS FOR NUCLEAR REACTORS (REPORT ON THE IAEA SYMPOSIUM IN VIENNA). K. H. Lindackers. Atomwirtschaft, 9: 115(Mar. 1964). (In German)

Physics and materials problems of reactor control rods discussed at the IAEA Symposium in Vienna are summarized. (M.C.G.)

21575 PLAIN AND ROLLER BEARINGS FOR EXTREME REACTOR CONDITIONS. F. Helfrich (Brown Boveri/Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirtschaft, 9: 126-8(Mar. 1964). (In German)

Bearings in reactor plants raise problems since the radiation, the surrounding atmosphere, and the frequently high ambient temperatures represent unusual conditions. The design of bearings to work in extremely dry helium atmospheres in nuclear reactors is described. It is shown that the values of friction and wear in very clean helium differ from those in air. All experiments proved that molybdenum disulfide is of supreme importance for the reduction of the coefficients of friction and wear. Graphite, the other dry lubricant which is frequently used, is not applicable in this case since it loses its lubricating properties because of the dryness of the ambient helium. The pretreatment of the surfaces and the means of introducing the MoS_2 are very important if good adhesion of the lubri-

cant to the metal is to be obtained. Bearings of the same materials but without MoS_2 treatment sized up very rapidly. Dry lubricated ball bearings were investigated at turning rates of about 100 rpm and temperatures of 150°C with MoS_2 applied after pretreatment of the surfaces by phosphating, etching, and sand blasting; also investigated were grease-lubricated ball bearings, oil-lubricated bearings and dry-lubricated plain bearings. With highly loaded plain bearings at 200°C a bearing coupling was in general only possible using MoS_2. (auth)

21576 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. III. THE PRESSURE VESSEL. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 15-21(Jan. 1964). (In French)

The merits of cylindrical and spherical metal vessels and of pre-stressed concrete vessels are discussed, together with the problems associated with their construction. The stresses to which the vessels are subjected, the resulting strains, and the conditions to be respected are considered. It appears that the concrete vessels permit higher coolant gas pressures and have a higher intrinsic safety. (D.C.W.)

21577 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. IV. THE GRAPHITE STACK. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 23-44(Jan. 1964). (In French)

The criteria by which graphite stacks are classified (geometry, stability, cohesion, etc.) are discussed, and the conditions which a stack must meet are given. A stack meeting all these restrictions is described. Specifically, its geometry is independent of dimensional variations of the graphite (Wigner effect). The principle of the calculation of the stability of such a stack is presented. Problems arising in the construction of a large-mesh lattice necessitated by the use of large annular fuel elements are considered. (auth)

21578 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. VII. FUEL HANDLING. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 59-70(Jan. 1964). (In French)

The fuel handling systems of the Calder Hall reactors have served as the design bases for most existing gas–graphite reactors. Changes have been made to permit fuel changes in operation. The operational principles of these systems are presented, and an alternate approach under study is described. The new approach uses an integrated handling machine — operations are performed in a pressurized compartment above the reactor vessel. Tests on a full-size model have been carried out at Saclay. (D.C.W.)

21579 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. IX. THE CONTROL RODS. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 75-81(Jan. 1964). (In French)

The adoption of an integrated fuel handling system does not leave room to bring conventional control rods to their upper position. Two types of solutions were studied: One, applicable to safety operations, uses absorbent metal balls which fall from storage magazines. The other, for control and compensation, uses borated metal chains. (D.C.W.)

21580 FAIL-SAFE CIRCUITS FOR NUCLEAR PROTECTIVE SYSTEMS. T. Businaro, L. Conti, and M. Conti (Comitato Nazionale per l'Energia Nucleare, Rome). IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 64-70(Apr. 1964).

A set of fail-safe logic blocks particularly suited to safety systems is described. The input information is normally +5 v; in case of alarm, the input drops to 0 v. Fundamental blocks (AND, OR, NOT, etc.) are pulsed-modulated, so as to achieve 0 v output voltage in case of failure. More complex logic function can be synthesized and redundancy can be employed in order to avoid erroneous action. (auth)

21581 ANALYSIS FOR DEFORMATION OF A NUCLEAR REACTOR GRID STRUCTURE. Algirdas Henry Marchertas. Thesis, Lincoln, Neb., Univ. of Nebraska, 1963. 134p.

A general procedure is presented for determining the deformation (slopes and deflections) of a grid support structure for a nuclear reactor. Use is made of the Rayleigh-Ritz method which utilizes an infinite series of polynomials. The grid structure consists of 2 circular perforated plates separated and interconnected by a large number of tubes. The holes are distributed in an hexagonal manner with respect to the center of the plates. Tubes pass through each hole and serve as supports for loads acting on the top end of every tube. The edges of the plates are peripherally supported and may have any degree of restraint ranging from fixed to simple supports. The complexity introduced by the holes in the plates is circumvented by the use of an equivalent solid plate. This idea, developed and substantiated by a number of investigators, is also applied to approximate pertinent stresses in the perforated plates. Solution to the problem is also given in the form of an IBM-704 Fortran II computer program. By the use of this program, a numerical example of the grid support structure of the Experimental Breeder Reactor II is presented for illustration. The results are discussed and a simplified procedure of solution is suggested. (Dissertation Abstr., 24: No. 8, Feb. 1964)

21582 NUCLEAR FISSION PROCESSES AND PLANT. (to Stichting Reactor Centrum). British Patent 954,407. Apr. 8, 1964. Priority date Dec. 30, 1960, Netherlands).

A method is given for the fine control of the power level of a homogeneous suspension reactor plant. The method comprises adding to the suspension fuel a low cross-section electrolyte in response to neutron flux fluctuations, thus making the power level more constant. A suitable electrolyte is sodium hydroxide. (D.L.C.)

21583 IMPROVEMENTS RELATING TO STORAGE APPARATUS INCLUDING A ROTATABLE DRUM. Albert Ince and Geoffrey Keith Soar (to AEI-John Thompson Nuclear Energy Co., Ltd.). British Patent 954,798. Apr. 8, 1964. Filed July 12, 1960.

An apparatus is designed for storing and changing the grabs from a remote handling apparatus (described in British Patent 879,528) for lifting broken fragments of fuel elements out of reactor channels. The apparatus comprises a container housing a rotatable drum store for housing a plurality of attachments, means for locating the handling apparatus centrally of the drum store, and a transfer member for transferring an attachment between the drum store and the handling apparatus. (D.L.C.)

21584 IMPROVEMENTS IN OR RELATING TO PLANT FOR TRAPPING RADIOACTIVE FISSION PRODUCTS. Samuel Brittan Hosegood (to United Kingdom Atomic Energy Authority). British Patent 955,345. Apr. 15, 1964. Filed Aug. 31, 1961.

A process plant is designed for removing fission products from a gaseous coolant coming from a nuclear reac-

tor. The plant comprises an absorbent material, e.g. charcoal, through which the gas is forced to pass and means for transferring heat from the gas to a condensible gas, e.g. nitrogen, circulated in a closed boiling/condensing circuit which includes a condensing coil located outside the radioactive field. Double containment is provided for the fission products, and the risk of ozone formation by irradiation of oxygen impurity in nitrogen is minimized. (D.L.C.)

21585 IMPROVEMENTS IN OR RELATING TO FLOW-LIMITING DEVICES FOR PRESSURE TUBE ASSEMBLIES. Rene Lemaitre and Roland Roche (to Commissariat à l'Energie Atomique). British Patent 955,526. Apr. 15, 1964. Priority date Apr. 13, 1961, France.

A pressure tube assembly for reactors with a liquid moderator and a gaseous coolant is designed with a device which produces a small head loss in normal operation but which, in case of rupture of the pressure tube, limits the flow rate until the tube can be closed off with a conventional closure means. The device comprises a restrictor nozzle located at both the inlet and outlet of the tube and having a minimum cross section at the throat portion which is dimensioned so that the normally subsonic flow becomes sonic when the flow rate exceeds a predetermined value. Several embodiments of the device are described. (D.L.C.)

21586 IMPROVEMENTS IN OR RELATING TO CHARGE/DISCHARGE SYSTEMS FOR GAS-COOLED NUCLEAR REACTORS. James Lewis Ayre (to Simon-Carves Ltd. and General Electric Co. Ltd.). British Patent 955,607. Apr. 15, 1964. Filed Apr. 7, 1961.

A charge-discharge system is designed for use in a gas-cooled reactor which is still being operated. The system includes a charging vessel with a magazine for the storage of fuel elements, a charge tube for charging and discharging any channel and which constitutes a gas flow path from the channel to the magazine, and a further tube for the return of coolant from the magazine to the reactor. Thus, the fuel elements in any channel being charged or discharged are arranged to remain in a gas-flow path and thus present a constant impedance to the gas flow. To prevent a higher-than-normal impedance should fuel elements be inserted in the further tube by mistake, a by-pass is provided in the charge tube in the reactor. The system is a modification of that described in British Patent 911,863. (D.L.C.)

21587 IMPROVEMENTS IN OR RELATING TO FLUID COUPLING DEVICES HAVING A SLEEVE MOVABLE BY FLUID PRESSURE. Jack Jones and James Harrison (to United Kingdom Atomic Energy Authority). British Patent 955,669. Apr. 15, 1964. Filed Feb. 10, 1960.

A remote-operated fluid coupling device is designed for effecting a seal between the charging barrel of a refueling machine and a reactor standpipe. The device comprises a tubular coupling member of stepped bore and a sleeve of stepped section movable in the bore between withdrawn and projecting positions, seals between the sleeve and the bore, and means for controlling a fluid pressure in the bore between the seals. (D.L.C.)

21588 SAFETY DEVICE FOR NEUTRONIC REACTOR. Werner Spillmann (to Escher Wyss AG). U. S. Patent 3,130,128. Apr. 21, 1964. Priority date Sept. 7, 1959. Switzerland.

A device is designed for the automatic stopping of a gas-cooled reactor by the release of a neutron-absorbent gas into the reactor. The device comprises an enclosed vessel filled with the neutron-absorbent gas and located in the central outlet space of the reactor, and at least one pipe leading from the vessel into the annular inlet space. The mouth of the pipe is closed with a closure member which opens when the vessel pressure exceeds a predetermined pressure. Thus, in the operation of the device, the neutron-absorbent gas is released into the incoming coolant and not into the outgoing coolant. (D.L.C.)

21589 NUCLEAR REACTORS. Roland Roche (to Commissariat à l'Energie Atomique). U. S. Patent 3,130,129. Apr. 21, 1964. Priority date Sept. 6, 1960, France.

A container for the liquid moderator in a nuclear reactor, is designed which has a variable moderator level for reactivity control and effective cooling of the container walls and of the horizontal pressure tubes. The container includes a bell immersed in the moderator at least as far as the minimum moderator level, and a gas pressure is set up beneath the bell so that the liquid fills entirely the space between the container and the bell. The gas pressure is varied to adjust the liquid level. Smaller bell means may also be provided for keeping the upper pressure tubes in contact with liquid even when the liquid level is below the tubes. (D.L.C.)

21590 CORE SUPPORTING ARRANGEMENTS FOR NUCLEAR REACTOR. Geoffrey Herbert Haines, Keith James Mitchell, and Raymond Hicks (to General Electric Co. Ltd. and Simon-Carves Ltd.). U. S. Patent 3,130,130. Apr. 21, 1964. Priority date Dec. 13, 1957, Great Britain.

A supporting arrangement for the pressure vessel of a heterogeneous reactor, is described with reference to a gas-cooled graphite-moderated reactor. In the arrangement, the pressure vessel is suspended from rigid support means by a plurality of suspension members attached to the pressure vessel at points distributed around the vessel. The suspension members are pivotally attached at both ends to the vessel and support means. The core within the pressure vessel may be suspended in a similar way to oppose the bending stresses at the points of attachment of the suspension members, or it may be simply supported by a skirt. The advantages of this supporting arrangement over one in which the pressure vessel is supported from beneath by a skirt or inverted A frames are that there is no compression and hence no tendency to buckle, the vessel has more freedom to expand or contract, and stresses are lower. (D.L.C.)

Criticality Studies

21591 (AEEW-M-425) A STUDY OF SOME CANADIAN EXPERIMENTS USING THE WINFRITH FIVE-GROUP SCHEME. J. R. Askew (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Jan. 1964. 18p.

As part of the justification of the Winfrith five-group scheme, a series of Canadian critical experiments was analyzed. These include 19- and 7-rod clusters, the latter with air and organic coolant as well as heavy water. Agreement of calculation with experiment on fast fission and conversion ratio is very good. Discrepancies of up to 2% in reactivity are traced to errors in fine structure which are due partly to the use of diffusion theory and partly to the method used to simulate end-regions. When fine structure is corrected the deviation of calculated k_{eff} from unity is less than 0.5% in practical cases. (auth)

21592 (ANL-6271) SAFETY ANALYSIS REPORT, ARGONNE FAST CRITICAL FACILITY (ZPR-VI). W. Y. Kato, G. J. Fischer, and L. R. Dates (Argonne National Lab., Ill.). Dec. 1963. Contract W-31-109-eng-38. 270p.

The ZPR-VI, now under construction, is a split-table critical assembly for studying the physics of fast reactors. Systems ranging from small, highly enriched cores to large, dilute configurations with core volumes up to about 1500 liters will be studied. The facility, its site, operation, and management are described, and the hazards analyses are summarized. The results show that only a combination of mismanagement and simultaneous electrical and mechanical malfunctions could create a hazard to the operating personnel and general public. (D.C.W.)

21593 (APDA-157) CALCULATION OF THE DOPPLER COEFFICIENT FOR PLUTONIUM-OXIDE-FUELED FAST REACTORS. E. A. Fischer (Atomic Power Development Associates, Inc., Detroit). Nov. 1, 1963. 179p.

The average resonance parameters for ^{239}Pu are determined by a detailed statistical analysis of the experimental material, whereas the resonance parameters for ^{240}Pu are obtained rather crudely by analogy with other isotopes because of lack of experimental data. Systematic calculations of the effective cross sections and their temperature derivatives were carried out using an improvement of Method B as described in APDA-139 for the three isotopes ^{238}U, ^{239}Pu, and ^{240}Pu. The results are presented in graphs. The resonance parameters for ^{238}U are taken from APDA-139. The Doppler coefficient is calculated for a large plutonium-oxide-fueled reactor. Also, an accurate calculation of the quantity $e^{(s)}$ of Nicholson's Method A is presented and the maximum likelihood method is described. (auth)

21594 (BNL-6975) A REVIEW OF THE REACTOR PHYSICS DATA FOR SLIGHTLY ENRICHED URANIUM, WATER-MODERATED LATTICES. Robert L. Hellens and Glenn A. Price (Brookhaven National Lab., Upton, N. Y.). [May 1, 1963]. Contract [AT(30-2)-Gen-16]. 168p.

The methods commonly used in making buckling, critical loading, and cell parameter measurements are reviewed, and the results of such measurements are summarized. Only simple uniform and multiregion lattice experiments are considered. The experimental work done at each of the laboratories involved is summarized. The methods of interpreting the various lattice measurements are briefly discussed, with emphasis on the sources of systematic errors. (D.C.W.)

21595 (CEA-R-2376) APPLICATION DE LA METHODE DES NEUTRONS PULSES SUR LES PILES ALIZE ET AQUILON. (Application of the Pulsed Neutron Technique on the Reactors ALIZE and AQUILON). René Jacquemart (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Feb. 1964. 39p.

Different methods of measuring the ratio effective delayed fraction/prompt neutron lifetime α_c are described. According to the classic pulsed neutron technique the negative reactivity due to a localized absorber is given by $\rho/\beta_{eff} = (\alpha/\alpha_c) - 1$. Experiments are reported which show that in this case α_c can not be considered constant for large reactivities. The absorber element distorts the flux in the system, increasing the importance of the reflector. An application of the pulsed neutron method to the measurement of critical distributed boron concentrations of various absorber elements is described. Less time is required than for the usual super-critical techniques, and the experimental analysis is simplified. Notably, the results are not influenced by the spectral sensitivity of the control element. A modified pulsed neutron method was used to determine the critical water level of uranium-heavy water lattices with a high precision by subcritical measurements. (auth)

21596 (EUR-597.e) CALCULATION OF D_2O-MODERATED LATTICES BY BASIC METHODS. B. Sturm (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1964. 32p. (CONF-469-2)

From the Conference on Physics of Reactors, Milan, Nov.-Dec. 1963.

For the calculation of D_2O-moderated, organic-cooled natural uranium lattices, a calculational procedure is proposed based on the most refined reactor codes available at Ispra. For the calculation of fast group constants, the GAM-I multigroup program is used. Weighting factors to take into account the heterogeneity of the lattice cell are calculated by the DSN program for macro- and micro-cells. For the calculation of thermal cross sections the THERMOS-code is used, and the disadvantage factors for the different materials in the cell are obtained by a one-group calculation using the DSN program. On the basis of this procedure, an analysis of critical experiments for 7-UO_2-rod, organic-cooled fuel elements was performed. Reasonable agreement was found for material buckling as well as for the measured thermal disadvantage factors, initial conversion ratio, and fast fission ratio. (auth)

21597 (EUR-1606.e) CAPRI A.B.—AN I.B.M. 7090 THERMAL UTILIZATION FACTOR CALCULATION PROGRAM ON THE RING METHOD OF AMOUYAL AND BENOIST. W. De Haan (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 18p.

The program CAPRI A.B. calculates the thermal utilization factor of a lattice with up to twenty regions by a method based on that of Amouyal and Benoist. The formulation and organization of the calculation are outlined, and input and output are described and illustrated. (D.C.W.)

21598 (IA-899) INELASTIC SCATTERING MATRICES FOR FAST REACTOR CALCULATIONS. G. Szwarcbaum, M. Sieger, and S. Yiftah (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Dec. 1963. 31p.

By minimizing the χ^2 function, improved values are obtained for the parameters of three formulas for nuclear temperatures (the formulas of Weisskopf, Bethe and Lang-Le Couteur). A comparison of the improved formulas shows that all fit the experimental data equally well and yield lower vaues for the nuclear temperature. On the basis of the improved Weisskopf formula, new multigroup inelastic cross sections are calculated and used in the calculation of several fast assemblies. The calculated critical masses are generally in slightly better agreement with experiment. An explanation of this effect is given. (auth)

21599 (NAA-SR-Memo-9382) STATUS OF ASCR CRITICAL AND SUBCRITICAL EXPERIMENT CORRELATION. E. R. Specht (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 12, 1964. Contract AT-11-1-GEN-8. 53p.

Material bucklings for UC fuel elements, enriched to 3.02% are inferred from critical experiments in which 24 UC fuel elements were surrounded by uranium metal fuel elements. The UC fuel elements were placed on triangular pitches of 9, 11, and 12 in. and the number of uranium

metal drivers changed to obtain criticality for each case. Four-group theory was employed to infer the material bucklings of each critical configuration by modifying the thermal absorption cross section of the UC region until the calculated value of k_{eff} was unity. Comparisons of theoretical calculations and "measured" material bucklings (B_m^2) indicate that multigroup theory (15 groups) does much better than few-group theory (2 to 4 groups). Because of the inherent simplicity of few-group theory (as compared to multigroup theory), an extensive comparison was made between various few-group theoretical calculations. These calculations determined the effect on the curve of material buckling versus lattice pitch when all flux shapes were calculated in each of the four energy groups (with diffusion theory) and with transport theory. Also, various treatments were employed to obtain cross sections for the thermal energy group. These included calculations with and without flux depressions across each fuel pin, with the fuel pins homogenized in various ways (over the process tube volume, over the rubber band surface of the pin cluster, and into several bands of UC), and a thermal multigroup calculation (using THERMOS). These few group calculations caused significant variations in the magnitude of the material buckling but did not produce the same shape for the curve of B_m^2 versus pitch as was obtained from the measurements. Measurements on subcritical assemblies of B_m^2 for ASCR lattices were found to vary considerably from the values of B_m^2 that were inferred from the critical assemblies. When the subcritical material bucklings are corrected by using calculated values of diffusion anistropy, most of the difference between the critical and subcritical values of B_m^2 disappears. (auth)

21600 (NAA-SR-Memo-9489) MULTIGROUP ANALYSIS OF UNIFORM ASCR LATTICES. R. H. Sevy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 4, 1964. Contract AT(11-1)-Gen-8. 30p.

Theoretical estimates of materials buckling, conversion ratio, epicadmium-to-subcadmium capture rate in ^{238}U, epicadmium-to-subcadmium fission rate in ^{235}U, and ^{238}U-to-^{235}U fission rate are made for several fuel element spacings in uranium monocarbide fueled, sodium-graphite lattices. The estimates are based on one-dimensional cell analysis using fourteen epicadmium energy groups and one subcadmium energy group. (auth)

21601 APPLICATION OF THE MONTE CARLO METHOD OF MULTIGROUP REACTOR CALCULATIONS. A. D. Frank-Kamenetskii. At. Energ. (USSR), 16: 119-22 (Feb. 1964). (In Russian)

The use of multigroup transport theory in Monte Carlo calculations reduces the required size of the computer memory, since the macroscopic cross sections $\nu_f\Sigma_f$, Σ_a and Σ_s and the group-transfer probabilities (including both elastic and inelastic scattering) need be stored only for each zone and energy group. Scattering is assumed to be isotropic in the laboratory coordinate system. The calculation of the trajectories and the number of neutrons in each group is done normally. At the beginning of the calculation T_0 neutrons of the first generation are distributed arbitrarily throughout a cylindrical reactor (r-z coordinates), with energies distributed according to the fission spectrum. Each neutron is followed until it either leaves the reactor or is absorbed. If it causes a fission, its coordinates are remembered, and $\nu_f\Sigma_f/\alpha\Sigma_a$ neutrons are added to the following generation. The normalization coefficient α is chosen so that $\nu_f\Sigma_f/\Sigma_a\alpha < 1$. After S preliminary generations the effective multiplication coefficient for the t-th generation (t > S) is calculated by either (1) $K_{eff} = \alpha(T_{S+1} + T_{S+2} + \ldots T_t)/[(t - S)T_0]$ or (2) by considering that at each collision $n_i = \nu_f\Sigma_f/\Sigma_t$ neutrons are born into the next generation, starting with generation S. After t generations $K_{eff} = (\Sigma\, n_i)/[(t - S)T_0]$, where n_i is summed over all collisions. In a sample calculation (1) converged in about 30,000 histories, and (2) in 25,000. The Monte Carlo calculation converges fastest when the ratio of the maximum length L of the active zone to M the migration length is about unity. It is just in this range of L/M that the diffusion approximation gives the largest errors. If there are a large number of groups and zones, the Monte Carlo calculation requires less machine time than does the diffusion approximation. (TTT)

21602 A STUDY OF THE EFFECT ON THE THERMAL DIFFUSION LENGTH OF EMPTY CHANNELS IN THE MODERATOR. I. F. Zhezherun. At. Energ. (USSR), 16: 123-30(Feb. 1964). (In Russian)

The thermal diffusion length L was measured in graphite prisms, which were placed on the thermal column of a reactor. The other faces of the prisms were covered with sheets of 5 mm Cd; a sheet of cadmium was placed between the prisms and the column in some experiments to measure the epithermal background. The neutron fluxes were monitored with a fission chamber 1 cm dia. × 1 cm, and by a BF_3 proportional counter 0.8 cm × 10 cm. For a solid prism 120 × 126 × 140 cm^3 (graphite density = 1.64 g/cm^3), $L_0 = 55.5 \pm 1.3$ cm. Measurements were also made on prisms with horizontal and vertical air channels (1.6 cm diameter) packed in lattices with steps of 2.83 and 2.00 cm. For the 2.83 cm step, $L_\perp = 74.6 \pm 1.9$ cm (horizontal channels, 120 × 120 × 140 cm^3 prism), and $L_{||} = 75.8 \pm 2.1$ cm (vertical channels, 120 × 120 × 180 cm^3 prism). For the 2.00 cm step, $L_\perp = 113.1 \pm 4.9$ cm (120 × 126 × 140 and 120 × 126 × 180 cm^3 prisms), and $L_{||} = 115.2 \pm 4.6$ cm (120 × 120 × 180 and 120 × 140 × 144 cm^3 prisms). The results were compared with those of published theories. Previously published experimental and theoretical work is reviewed (42 references). (TTT)

21603 AN ANALYTICAL APPROACH FOR THE COMBINED AGE-DIFFUSION EQUATION. Fumio Amano (Electrotechnical Lab., Tokyo). Denki Shikensho Iho, 27: 721-34 (Oct. 1963). (In Japanese)

An analytic method is developed for the solution of the multiregion reactor system. The neutron fluxes are expanded in a series of eigenfunctions which are solutions of the Helmholtz equation, the eigenvalue problem is derived from the equation satisfied by these expansion coefficients, and thus the criticality condition considering completely the fast-neutron-flux space dependence is derived. This method is developed for one- and two-dimensional problems. As an example, calculations for a fictitious slab reactor are made on the IBM-7090 and ETL Mark V. (auth)

21604 COMPARISONS OF NUCLEAR CHARACTERISTICS BETWEEN CIRCULAR CORE CELL AND RECTANGULAR CORE CELL AS MATERIAL ENGINEERING TEST REACTOR. Kazuo Nishimura, Akikazu Iwase, Toshitake Takahashi, Hifumi Yanagisawa, Yoshio Fukumitsu, Hiroyuki Matsunobu, and Toru Maejima. Nippon Genshiryoku Gakkaishi, 6: 144-53(Mar. 1964). (In Japanese)

A comparison of nuclear characteristics was made between the circular cell (BR-2 type core unit cell), and the rectangular cell (ETR type core unit cell) in the Material Engineering Test Reactor. The uranium weight ratio of U–Al alloy for the meat of fuel plates was taken as a pa-

rameter. Design parameters such as critical mass, average flux of the loop per unit power, allowable maximum flux of the loop, mass coefficient, and void coefficient were examined as criterions for the comparisons. In view of the co-existence of beryllium and light water in the circular cell, the advantage of beryllium was studied. In the calculation, the thermal utilization of the circular cell was estimated as exactly as possible, solving the space dependent thermalization formula. It was concluded that the fuels can be loaded in the rectangular cell more tightly than in the circular cell. The uranium weight ratio may be adjusted in accordance with the requirement when high allowable flux of the loop or high flux of the loop per unit power is desired. If the gap of the tightly loaded circular cells is filled with beryllium, which has smaller absorption cross section than light water, and if the uranium weight ratio can be adjusted easily according to the requirement, it might be said that the circular cell has some advantage because of the improved thermal utilization. The negative void coefficient in the circular cell can be obtained more easily than the rectangular one. (P.C.H.)

21605 A PULSED NEUTRON SOURCE FOR REACTOR MEASUREMENTS. P. D. Lomer, J. D. L. H. Wood, and R. C. Bottomley (Services Electronics Research Lab., Baldock, Herts, Eng.). Nucl. Instr. Methods, 26: 7-12 (Feb. 1964).

A compact neutron tube capable of producing 10-μsec pulses of neutrons at a rate of 5×10^{13}/second (5×10^{8}/pulse) has been developed. The tube, which uses the D-T reaction, consists of a P.I.G. ion source from which deuterons are accelerated onto a tritium-loaded titanium target. The design features which lead to these high output rates are discussed. The incorporation of the tube into a reactor probe operating at levels up to 10^{8}/pulse is described. Pulse-to-pulse variations are small and a high degree of reliability has been achieved with the complete system. (auth)

21606 TWO-GROUP MATERIAL BUCKLINGS IN A TWO-REGION SYSTEM. W. B. Lewis (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Sci. Eng., 19: 131(May 1964).

The criticality of a two-region system can be attained even if the material-buckling equation has no positive root. A long cylinder of natural uranium surrounded by a moderator constitutes such a system. (R.E.U.)

21607 ON THE (Kβ/l) PULSING THEORY. Edward Garelis (General Electric Co., [Pleasanton, Calif.]). Nucl. Sci. Eng., 19: 131-2(May 1964).

It is shown that the monoenergetic diffusion-theory approximation used in pulsed-neutron source measurements for the (kβ/l) technique can be replaced by the monoenergetic transport-theory approximation. The value (kβ/l) coupled with the α measurement of a subcritical assembly yields the reactivity directly. See also NSA 17: 31697. (R.E.U.)

21608 COMPARISON OF CALCULATED AND ACTIVATION-DETECTOR-MEASURED ENERGY DEPENDENCE OF NEUTRON FLUXES. W. Koehler (Technische Hochschule, Munich). Nukleonik, 6: 24-7 (Feb. 1964). (In German)

The neutron flux per energy interval for the core of a light-water-moderated reactor was calculated with regard to inelastic scattering on aluminum and the finite dimensions and compared with measurements using a threshold detector. In the range for which no measuring method exists (1 kev to 1 Mev), the calculated course was compared with similar calculations, interpolations between the measured fast flux and the measured resonance flux were examined by the method of Genthon and the flux was integrated over the neutron energy range. (tr-auth)

21609 A GENERALIZED METHOD FOR CALCULATING THE FAST FISSION EFFECT IN COAXIAL CYLINDRICAL LATTICE CELLS. H. Maerkl (Siemens-Schuckertwerke AG, Erlangen, Ger.) and A. G. Fowler. Nukleonik, 6: 39-51(Feb. 1964).

A method is presented for calculating the fast fission effect in a heterogeneous lattice cell consisting of arbitrarily many coaxial cylindrical regions. The theory results from an extension to two groups of A. Müller's version of Amouyal's and Benoist's one-group method for calculating thermal utilization taking into account neutron regeneration within the groups. This generalized procedure, which involves the formulation of neutron balance equations by means of neutron currents and collision probabilities, is applicable to fast fission calculations taking into account backscattering and fast interaction effects. For fuel elements consisting of several annular fuel regions the fast fission ratios can be calculated for each region separately. The classical theory of Fleishman and Soodak for single fuel rods is contained in the method described as a particular case. An advantage results from the fact that all the collision probabilities involved in the procedure can be expressed in terms of two probabilities for which sufficiently accurate approximations are available. The theory was checked against experimental values of fast fission ratios of single metal and oxide rods as well as 7- and 19-element clusters with different coolants. A satisfactory agreement between theory and experiment was obtained. Both experiment and theory showed an appreciable backscattering and fast interaction effect, the latter being observed up to lattice pitches of about 20 cm. (auth)

Design and Feasibility

21610 (AEEW-R-135) METHUSELAH I—A UNIVERSAL ASSESSMENT PROGRAMME FOR LIQUID-MODERATED REACTOR CELLS, USING IBM 7090 OR STRETCH COMPUTERS. R. Alpiar (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1963. 87p.

The program METHUSELAH I, in Fortran for the IBM 7090 or STRETCH computers assesses the physics of the initial conditions and the life histories of liquid moderated reactor cells. A wide choice of cell design, fuel element shape and burnup control mechanism is available. A specially designed input scheme simplifies the preparation of data. Effects covered in the calculation include estimation of the effects of fuel pin hyperfine flux structure, resonance shielding, doppler broadening, disturbances due to water gaps, control blades or few group neutron diffusion across the cell, moderator regions of different properties, and a comprehensive system of burn up equations. Intermediate results are stored and made available at the user's discretion. The final output includes the cell lifetime, reactivity and fluxes, the isotopic composition of the fuel, the thermal neutron spectra in the cell, and other quantities as required. Additional facilities include automatic data modification for subsequent cases, temporary alteration of library cross sections, temporary program modification (in the STRETCH version only), an iterative

technique for improving the thermal neutron spectra, and calculation of the reaction rates of specified detectors. (auth)

21611 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. VI. THE CHOICE OF THE GAS-FLOW DIRECTION. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 55-8(Jan. 1964). (In French)

The advantages and disadvantages of using a downward gas flow rather than the conventional rising flow are summarized. The inverse flow (adopted for future reactors), notably, permits an increase in the specific power of the fuel elements without inducing problems with their extraction. (D.C.W.)

Fuels

21612 (CEA-2387) ETUDES EXPERIMENTALES DE STRUCTURE FINE A L'INTERIEUR DE GRAPPES D'OXYDE UO_2. (Experimental Studies of the Refined Structure Within UO_2 Clusters). P. F. Palmedo (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Mar. 1964. 31p.

General measurements of neutron fine structure in various UO_2 clusters are described. The experimental techniques that were found useful are presented, as well as the methods of experimental analysis. The results are given in detail. A semi-empirical relation for the fine structure in clusters is suggested and is compared with the various results. (auth)

21613 (HW-79960) REACTIVITY MEASUREMENTS OF MIXED OXIDE FUEL ELEMENTS. V. O. Uotinen and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Dec. 11, 1963. Contract [AT(45-1)-1350]. 8p.

The relative worths of six PuO_2–UO_2 fuel elements and a Pu–Al fuel element in the center of the Plutonium Recycle Critical Facility were determined from positive period data. Five of the PuO_2–UO_2 elements will go into the PRTR; the sixth will be retained as a standard. The worths of the five elements relative to the standard, D_2O, and Pu–Al were obtained. The variation in worth relative to D_2O of the five elements was 1%. An inconsistency (within 1%) between the measured worths and the PuO_2 content of the elements was observed. The use of total reactivity worth as a criterion indicates that the fabrication of the PuO_2–UO_2 elements was very uniform. (D.C.W.)

21614 (NAA-SR-Memo-8017) DESIGN OF NAA-62-2. H. B. Brooks (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 3, 1963. Contract AT(11-1)-Gen-8. 79p.

A series of in-pile experiments was designed for evaluation of a prototype fuel element to operate under approximate ASCR conditions. The fuel surface temperature will be automatically controlled by means of a BF_3 thermal neutron flux control system. Complete design calculations and results are presented, which should be adequate for presentation of the experiment to the ETR safety committee. (auth)

21615 (NAA-SR-Memo-9164) VIBRATION STUDIES OF THE LARGE SGR FUEL ELEMENT AND PROCESS CHANNEL. J. H. Brindley, D. J. Kniley, and M. M. Lemcoe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 18, 1964. Contract AT-11-1-GEN-8. 39p.

An analysis of the vibrational characteristics of the presently designed SGR fuel-element and process-channel was made to determine the possibility of component failures from hydraulically induced structural vibrations. Predicted fuel-rod displacements as a function of coolant velocity and unsupported length have been calculated from existing correlations. Required frequencies and amplitudes of vibration estimated to cause failure from cyclic bending-fatigue and fretting-fatigue are presented. Experiments are herein described which will determine the vibrational characteristics, and whether fretting tests at elevated temperature in sodium are required of the fuel element and process assembly. To provide adequate confirmation of the calculated vibrational characteristics, the following test program is recommended: (1) An instrumented structural room temperature laboratory vibration survey to (a) effectively locate the sensors, (b) determine vibration modes (amplitudes and frequencies), and (c) check out instrumentation system for laboratory and hydraulic-loop tests. (2) A hydraulic-loop study to determine the characteristics of the structural vibrations produced under hydraulic-flow conditions. (3) If, after determination of the vibrations present, a question of component failure still exists, a process channel section would be tested at 1200°F in sodium at the required vibratory stimulus to more adequately define the damage occurring over a defined service life. The theoretical analysis indicates with conservative assumptions that vibrational characteristics and hydrodynamic loadings on the element will be considerably lower than required to cause fuel element component failure during a three year operational life, unless the cumulative damage from the higher frequencies is greater than envisaged in this preliminary evaluation of the problem. Consideration of any other process-channel-component (orifice assembly) vibrational damage is not undertaken in this study. (auth)

21616 (NAA-SR-Memo-9569) 1000-Mwe SGR. 90% ThO_2, 10% UO_2 ALTERNATE FUEL CORE THERMAL AND HYDRAULIC ANALYSIS. J. K. Imig (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 19, 1964. Contract AT(11-1)-Gen-8. 7p.

The thermal and hydraulic core parameters were determined using the SORTD I code for 90% ThO_2, 10% UO_2 fuel both for (1) a core containing 592 fuel elements corresponding to the UC reference core with a maximum UC temperature of 2000°F and (2) a core containing 784 fuel elements corresponding to a UC core with a maximum UC temperature of 1750°F. Eighteen rod elements with 2.5 $in.^2$ and 3.5 $in.^2$ fuel areas, and 30 rod elements with 4.5 $in.^2$ and 5.5 $in.^2$ fuel areas are analyzed for 8 cases. (auth)

21617 (TID-7694(p.71-84)) THE NUCLEAR VAPOTRON. Ph. Demange, E. Douguet, and J. D. Le Franc (Compagnie Francaise Thomson-Houston, Paris).

Adaptation of the Vapotron process to boiling-water reactors is discussed. The Vapotron process, as developed, related essentially to electron power tubes and to the cooling of their anodes by boiling water. The conventionally isothermal transfer surface is replaced by a surface provided with fins or corrugations on which a temperature gradient is set up. The effects produced by this gradient make it possible to obtain total thermal fluxes 2 to 4 times higher than those that could be extracted from isothermal surfaces under the same conditions. The Vapotron effect is defined thus: when the cold extremity of the sample reaches a certain temperature, boiling ceases to occur on the surface, which is surrounded by a blanket of steam and which is operating wholly within the film vaporization

zone. Photographs and graphs of test results are included. (M.C.G.)

21618 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. V. THE FUEL ELEMENTS AND THEIR JACKETS. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 45-54(Jan. 1964). (In French)

The evolution of fuel element geometry is summarized, and the advantages and disadvantages of using graphite jackets to support vertical fuel elements independently are reviewed. (D.C.W.)

21619 BEHAVIOUR OF FUELS AT HIGH BURN-UP LEVELS. PART 2. THERMAL REACTOR FUELS. B—COATED PARTICLE FUELS. J. B. Sayers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Eng., 9: 135-41(Apr. 1964).

The fabrication and irradiation behavior of coated-particle thermal reactor fuels are discussed. Fission product release, volume changes in the fuel kernel and coating material, phase composition, and burnup of pyrolytic carbon-coated UC_2 particles are considered. (R.E.U.)

21620 UO_2 FUEL CAPABILITY EXTENDED ABOVE MELTING POINT. M. F. Lyons, B. Weidenbaum, R. C. Nelson, T. J. Pashos, and C. R. Wilson (General Electric Co., San Jose, Calif.). Nucleonics, 22: No. 5, 102(May 1964).

An irradiation test program was conducted to determine operating limits of UO_2 fuel. It was shown that both pellet and powder UO_2 are able to operate far beyond the central-melting limitation when rods are properly designed. Results of some of the tests are given. A molten ceramic fuel concept where the cladding provides structural support to a UO_2 vessel containing molten UO_2 is found feasible. (M.J.T.)

21621 DEVICE FOR ALIGNING FUEL CARTRIDGES IN A REACTOR CHANNEL. Jean Liermann (to Commissariat à l'Energie Atomique). British Patent 954,776. Apr. 8, 1964. Priority date Apr. 6, 1962, France.

A simple device is designed for coaxially aligning fuel cartridges with one another when they are stacked in a reactor channel. The device comprises a male portion and a female portion which are each secured to one of the terminal plugs so that they surround the bearing surfaces of the plugs. Each male portion is an annular ring having a semi-toroidal outer surface, and each female portion is an annular ring having a frusto-conical surface. The male and female portions have sufficient longitudinal clearance between them so that each cartridge rests on the one below it through the terminal plugs. The function of the device is described. (D.L.C.)

21622 DEVICE FOR THE TRANSMISSION OF A POTENTIAL DIFFERENCE BETWEEN TWO SUCCESSIVE CARTRIDGES STACKED IN A CHANNEL OF A NUCLEAR REACTOR. Jean Liermann (to Commissariat à l'Energie Atomique). British Patent 954,777. Apr. 8, 1964. Priority date Apr. 10, 1962, France.

A device is designed for transmitting an electric potential difference from one reactor fuel cartridge to another, such as in temperature measurement by means of a thermocouple probe. The device comprises, on each end plug of each cartridge, a fixed central stud and a peripheral stud supported on the upper edge of a resilient annular cup. The fuel cartridge ends are also provided with male and female annular members for centering the cartridges, such as described in British Patent 954,776. Electrical connections are made when the fuel cartridges are aligned and in contact with each other through their end plugs. (D.L.C.)

21623 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Peter Waine (to United Kingdom Atomic Energy Authority). British Patent 955,336. Apr. 15, 1964. Filed July 12, 1960.

A reactor fuel element comprising a stack of UO_2 pellets in a protective sheath, e.g. stainless steel, is designed which solves the problem of straining due to differential expansion. The UO_2 pellets each have at least one end shaped to have a flat rim around a depression. The depressions generally have a depth 0.01 to 0.001 of the pellet length and a diameter 50 to 80% of the pellet diameter, and they allow a degree of axial expansion of the fuel at the centers. Typical pellet and depression diameter are given for a 100-Mw(t) gas-cooled reactor with a core outlet temperature of 525°C. The assembly of the fuel element is described. (D.L.C.)

21624 IMPROVEMENTS IN OR RELATING TO COOLING ARRANGEMENTS FOR NUCLEAR REACTOR FUEL ELEMENTS. Jean Le Foll (to Commissariat à l'Energie Atomique). British Patent 955,425. Apr. 15, 1964. Priority date Aug. 13, 1959, France.

A finned fuel element is designed with means for improving the heat exchange between the fins and the coolant. The means comprises deflection surfaces symmetrically arranged at the periphery of the transverse fins and inclined to the longitudinal axis of the element. Thus, the coolant is led transversely into the circular channels delimited by the fins. Several embodiments of the fuel element are described. (D.L.C.)

21625 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Jean-Francois Faugere (to Commissariat à l'Energie Atomique). British Patent 955,426. Apr. 15, 1964. Priority date Feb. 15, 1961, France.

A finned fuel element is designed with flat transverse fins and deflector members inclined to the coolant flow. Apertures are provided in some of the fins for interconnecting the channels between adjacent fins and thus reducing the pressure loss. The deflector members are in the form of triangular vanes secured to longitudinal backbones fixed to the fin peripheries. The fuel element is a modification of the fuel element described in British Patent 955,426. (D.L.C.)

21626 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Raymond Hippolyte Firmin Marchal and Rene George Julien Oebelieu (to Societe Nationale d'Etude et de Construction de Moteurs d'Aviation). British Patent 955,485. Apr. 15, 1964. Priority date Dec. 11, 1959, France.

A fuel element of the bundle or concentric cylindrical ring type is designed in which the surface thermal flow is equal over all the parts of the element and consequently only a minimum cladding surface is needed. The enrichment in fissionable material is increased from the exterior to the center of the fuel element so that a uniform surface thermal flow is obtained. Several embodiments of the fuel element are described. (D.L.C.)

21627 FUEL ELEMENTS FOR USE IN NUCLEAR REACTORS. Ian Hugh Morrison (to United Kingdom Atomic Energy Authority). U. S. Patent 3,131,129. Apr. 28, 1964. Priority date Oct. 14, 1955, Great Britain.

A reactor fuel element comprising a U fuel member encased in a protective sheath of Mg or Mg alloy, is designed to reduce cumulative stretching of the sheath in thermal cycling of the element due to the large thermal expansion of the sheath material. The fuel member is provided with a series of spaced concavities on its surface, and the finned sheath is indented into the concavities. The pressurizing operation for the indentation process and the optimum dimensions and spacing of the concavities are discussed. (D.L.C.)

Power and Power-Breeder Reactors

Refer also to abstract 20457.

21628 (ACNP-63033) PATHFINDER ATOMIC POWER PLANT. ANALOG SIMULATOR RESULTS. J. T. Stone, J. A. Nevshemal, D. Mohr, and G. C. Rudy (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). Mar. 6, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT-(11-1)-589. 118p.

The results of the dynamics testing of the Pathfinder plant as simulated on an analog computer are presented. Operational, accident, parameter, stability, and specialized studies are covered. (D.C.W.)

21629 (ACNP-63638) PRODUCTION OF SM-1 CORE III. Final Report. (Allis-Chalmers Mfg. Atomic Energy Div., Washington, D. C.). Dec. 1963. Contract AT(30-1)-3106. 14p.

The qualification and production of stationary fuel elements, control-rod fuel elements, neutron absorber sections, and dummy fuel elements are described. The entire core was manufactured with no rejections of fuel element or absorber assemblies. Fuel plates were produced with a reject rate of about 9%, and the product was consistently of high quality. The difficulties encountered in production and qualification were solved without compromising the product. (D.C.W.)

21630 (CVNA-202) CAROLINAS-VIRGINIA NUCLEAR POWER ASSOCIATES, INC. RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report, October–December 1963. (Westinghouse Electric Co. Atomic Power Div., Pittsburgh). Contract AT(30-1)-2289. 42p.

A significant amount of physics testing was accomplished until the work was interrupted when abnormally high concentrations of chlorides and fluorides were found in the header cavity drains. The header cavity insulation was determined to be the cause, and steps were taken to replace this insulation. The reactor was taken to a power level of 30 Mw(t). Preliminary analysis of the data obtained during this run showed that the heat losses to the moderator were lower than originally calculated, lending verification to some of the results obtained during earlier tests. Information was also obtained on: primary coolant system pressure drops, chemistry program, chemical analysis, performance of moderator ion exchanger during high fluoride period, coolant flow distribution in core, coolant-to-moderator heat losses, in-core instrumentation, moderator and coolant temperatures, power distribution, flux wire nuclear factors, ultrasonic inspection of pressure tubes, metallurgical examination of components, and plant evaluation. (N.W.R.)

21631 (CVNA-203) MONTHLY OPERATING REPORT, MARCH 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). 38p.

When difficulties were encountered with the control rod drive system at low header cavity temperatures, scram times showed significant increases. Increased friction was only observed under low-temperature (80°F) high-humidity conditions in the header cavity after the reactor had been shut down for a long period of time. Disassembly of rod drive components revealed no obvious mechanical reasons for the problem. The reactor was operated to perform several low power physics tests and preparations were made for power operation. Rod scram times were determined periodically during this period and the results were good. The reactor was opreated at powers up to 36.5 Mw(t), and 8.3 Mw(e), for twelve days, including eight days of continuous operation. (auth)

21632 (DP-866) HEAVY WATER REACTORS FOR SEA WATER DISTILLATION PLANTS. Daniel S. St. John, Charles P. Ross, and James W. Wade (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Jan. 1964. Contract AT(07-2)-1. 58p.

Conceptual designs of reactors moderated with D_2O were prepared for a study of the use of large reactors for sea water distillation. Two designs are presented: a near-term reference design producing 3500 Mw thermal with pressurized liquid D_2O coolant, and a more advanced design producing 8300 Mw thermal with organic coolant. Steam costs are estimated for dual-purpose plants in which the by-product steam from back-pressure turbines is sent to the saline water plant. These estimates show that the net steam cost varies from 11 to 16¢/million Btu for the 3500-Mw(t) plant, and from 4 to 9¢/million Btu for the 8300-Mw(t) plant, as the power credit changes from 3 to 1 mill/kwh. (auth)

21633 (DPST-64-83-1) USAEC-AECL COOPERATIVE PROGRAM MONTHLY PROGRESS REPORT, JANUARY 1964. H. S. Hilborn, comp. (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). 17p.

Activities are summarized on the following programs in relation to their use in the development of heavy-water moderated power reactors: effect of rod spacing on heat transfer burnout, sieve tray test, hydride orientation and mechanical properties of thin-walled Zircaloy tubing, and microprobe study of Zircaloy corrosion films. The sieve tray test is concerned with the modification of equipment and evaluation of the capacity of sieve trays with both segmental downcomers and downpipes and bubble cap trays with both downcomers and downpipes in order to produce heavy water economically. (N.W.R.)

21634 (GEAP-3971) VBWR STABILITY TEST REPORT. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 1963. Contract AT(04-3)-189. 376p.

The results of power stability tests conducted in the Vallecitos Boiling Water Reactor with both natural and forced coolant flow over a wide range of flows and powers are presented and are compared with analytical results. The experimental facility, procedures, data reduction, and analyses are described. A pre-test analysis of the stability tests was performed. (D.C.W.)

21635 (GEAP-4481) FUEL CYCLE PROGRAM—A BOILING WATER REACTOR RESEARCH AND DEVELOPMENT PROGRAM. Fourteenth Quarterly Progress Report, October–December 1963. C. L. Howard, comp.

(General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 7, 1964. Contract AT(04-3)-189. 78p.

The irradiation and examination of a large number of stainless steel and zircaloy clad UO_2 fuel assemblies operated at high specific power in the VBWR are reported. The design and fabrication characteristics of the basic fuel are presented. Operational data for fuel rod failure are outlined. (C.E.S.)

21636 (HW-72844) SHIELDING CALCULATIONS FOR A POWER REACTOR. E. G. Peterson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 28, 1962. Contract AT(45-1)-1350. 9p.

Five types of thermal shielding enclosed by ordinary concrete were analyzed. Thermal shields include ordinary water, borated carbon steel, cast iron, a mixture of magnetite and water, and borated graphite. For the current study it is concluded that the use of boron and cast iron as a thermal shield cannot be justified economically although they possess excellent shielding properties. The magnetite-water mixture (light water with magnetite ore added) is the best choice for a thermal shield because of its relatively low cost, excellent heat transfer properties, and the fact that cooling pipes are not needed in the concrete. (auth)

21637 (NAA-SR-Memo-8214) PROCEDURES AND ANALYTICAL METHODS FOR HNPF CARBURIZATION SURVEILLANCE. W. H. Wickes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 19, 1963. Contract AT(11-1)-Gen-8. 9p.

To minimize the possibility of any stainless steel core structure fatigue failures due to changes in physical properties from carburization, a program of carburization surveillance was initiated. Data on sodium samples, taken during the period of the initial sodium fill and low-temperature operation, are summarized. Carbon removal equipment is briefly described. Procedures for taking samples and methods for their analyses in a continuing program are presented along with criteria for evaluation of results. A search for a correlation between carbon contents of the reactor cover gas and the primary sodium coolant is recommended and a procedure for obtaining data is outlined. (auth)

21638 (NAA-SR-Memo-8266) FUEL ELEMENT GRAPPLE AND FUEL ELEMENT HOLD-DOWN LATCH DEVELOPMENT — LARGE SGR FUEL HANDLING. R. M. Ybarra (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 28, 1963. Contract AT(11-1)-Gen-8. 13p.

A fuel element hold-down device, which is an integral part of the fuel element assembly, was developed to lock reactor fuel to the bottom grid plate. Concurrently with the hold-down latch development, a fuel handling machine grapple capable of setting, releasing, and checking the hold-down device was developed. (auth)

21639 (NAA-SR-Memo-9241) 200-Mwe SGR UPPER PLENUM COOLANT REMOVAL HYDRAULICS. F. Bergonzoli (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 18, 1963. Contract AT(11-1)-Gen-8. 9p.

The hydraulics of uniform removal of sodium from the 200 Mw(e) SGR upper plenum through openings along a circumferential baffle, and of the flow in the annular channel to the outlet nozzle were analyzed. This arrangement was proposed to eliminate the possibility of vortexing in the upper plenum, hence to reduce the sodium pool height requirements. The analysis considered a constant flow area in the annular channel and a uniform discharge into the channel through the circular openings, acting as orifices. Selected results of the analysis are presented for various opticnal annular geometries and opening areas. For opening area giving a pressure drop greater than 0.50 psi, essentially uniform coolant removal may be obtained without variation in the diameter of the circular openings along the length of the channel. For opening pressure drop less than 0.50 psi, the annular channel frictional losses become important and variation in opening areas as a function of the channel length is required for uniform coolant removal. A recommended arrangement, based on opening pressure drop of 0.50 psi, is three rows of 30 equally spaced openings of 5" diameter, an annular channel width $\geq 10"$, and an annular channel flow area ≥ 4.2 ft^2. (auth)

21640 (NAA-SR-Memo-9391) CALCULATING AND CONTOURING RELATIVE POWER AND FUEL ELEMENT EXPOSURE FOR THE HALLAM NUCLEAR POWER FACILITY (HNPF) USING THE IBM-7094 AND SC-4020. J. C. Dillon and R. M. Mills (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 1964. Contract AT(11-1)-Gen-8. 63p.

Data taken at the HNPF site is transmitted to AI for reduction and analysis. A digital computer is used to reduce the data, compute relative power across the core, calculate fuel element exposure, and automatically generate contour plots of the relative power and/or element accumulated exposure. Timely, accurate, and inexpensive data reduction is accomplished. (auth)

21641 (NP-13793) REVISED REPORT ON CONTAINMENT OF FERMI REACTOR PLUG. Report No. 46-15-130. R. Michel and L. L. Kintner (Allis-Chalmers Mfg. Co. Atomic Energy Div., Washington, D. C.). June 6, 1961. 61p.

The effects of nuclear incidents having a range of heat energy release from 3×10^8 to 8×10^8 calories were studied. Energy release was assumed to be instantaneous, since in even the low-energy cases release occurs in less than two milliseconds. A range of initial gas volumes (within the reactor vessel) from 11.65 to 430 ft^3 was considered. Thermodynamic properties of liquified and vaporized core materials were obtained. Heat radiation from a uranium vapor bubble was calculated for the anticipated range of densities and temperatures. Various methods of absorbing the impact resulting from an excursion of the plug were examined, including hydraulic shock absorbers (16-in. naval gun recoil mechanisms), wooden layers, and aluminum absorbers. The latter have a greater energy absorption capability per unit weight and volume and were therefore selected for more detailed designs. Two general methods were studied: restraining the plug at the top of the reactor so that the travel is limited to a few feet and allowing the plug to rise freely until its motion was arrested either by absorbers attached to the machinery dome or the containment vessel. Aluminum absorbers with crushing strengths of 800 and 1200 psi were studied. Ten different methods of arresting the plug excursion were considered but not all were studied in detail. Drawings and cost estimates were prepared for these methods. (auth)

21642 (NYO-3250-1) REFERENCE PLANT DESIGN REPORT. PRELIMINARY HAZARDS SUMMARY REPORT. (Connecticut Yankee Atomic Power Co., Boston). Dec. 1963. Includes Appendix A: REPORT ON GEOLOGY AND FOUNDATION CONDITIONS AT HADDAM NECK SITE FOR CONNECTICUT YANKEE ATOMIC POWER COM-

PANY, BERLIN, CONNECTICUT. (Stone and Webster Engineering Corp., Boston). Oct. 1963. Appendix B: PART I. REPORT ON SEISMIC SURVEY, EAST HADDAM, CONNECTICUT. PART II. REPORT ON SEISMIC SURVEY FOR BORROW MATERIAL. (Weston Geophysical Engineers, Inc., Mass.). Aug. 1963. Contract AT(30-1)-3250. 337p.

This report supersedes NP-13088.

The site and nuclear power plant are described, and the results of the hazards analysis are presented. The reactor, shielding containment, and systems are covered, together with the test plans, operating procedures, and personnel organization and training. Geological, seismic, topographical, and meteorological information on the site is included. (D.C.W.)

21643 (WAPD-MRP-107) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, October 24, 1963–January 23, 1964. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 137p.

Progress on the Shippingport Pressurized Water Reactor is reported. Topics covered include: plant modification, plant decontamination, reactor engineering, metallurgy of core materials, core operation, and reactor physics. (N.W.R.)

21644 (AEC-tr-6385) HOW DOES THE STATE HELP THE ATOMIC INDUSTRY UNTIL ATOMIC ENERGY HAS BECOME A COMMERCIAL PROPOSITION? Translated from Atomwirtschaft, 9: No. 2, 46-53(Feb. 1964). 32p.

Six questions regarding the development of the atomic industry are answered by representatives of atomic energy programs in West Germany, France, Great Britain, Italy, Belgium, Netherlands, Norway, Austria, Sweden, and Switzerland. These questions cover the necessity of a long-term rigid program, the number of reactor types that can be developed, how much and what kind of financial help from the State, required uranium supply, and natural-uranium versus enriched-uranium reactors. (D.L.C.)

21645 THE FUTURE OF POWER GENERATION AND THE RISKS OF THE POWER INDUSTRY. H. Mandel. Atomwirtschaft, 9: 102-8(Mar. 1964). (In German)

A realistic assessment of the technical and economic risks associated with the use of nuclear energy for power generation is considered possible only if they are viewed as part of the total risks of the electricity generating industry. Among the various areas of risk, from the estimation of future power sale and ways and means of power generation through the planning and construction of power stations to the final operating results, the risks associated with the actual costs of power generation occupy an essential place. The risks connected with power sale and with distribution costs are almost equally important. For generating costs the greatest risk is associated with the primary energy costs and especially with the evolution of the cost relations between primary energy sources of different kinds and origins: water power because of its price advantage, non-substitutable fuels (brown coal, coal for mining power stations etc.), and substitutable fuels (indigenous and imported hard coal, natural gas, oil, and nuclear energy). Their present relation to one another and probable or possible developments are considered. In addition to the question of the cost relations between the primary energy sources there is also the question of the security of their supply. Here again these are risks, though security can be guaranteed by mixing primary energy sources of different kinds and provenance in a way which was not thought possible ten years ago. It was concluded that nuclear energy will attain economic significance in the German Federal Republic and become competitive, particularly with hard coal and oil, within the next ten years thereby offering a greater security of supply than fossil fuels. (auth)

21646 MECHANICAL PROBLEMS ENCOUNTERED IN GAS–GRAPHITE REACTORS. II. GENERAL STRUCTURE. R. Martin. Bull. Inform. Sci. Tech. (Paris), No. 79, 11-13 (Jan. 1964). (In French)

The general features of gas-cooled, graphite-moderated reactors are summarized; typical values for some parameters are given. Some mechanical problems that must be considered in developing a specific reactor are also indicated. (D.C.W.)

21647 THE "MAXIMUM CREDIBLE ACCIDENT" AND SOME CONSTRUCTIVE REQUIREMENTS IN THE CHOICE OF THE CONTAINERS FOR NUCLEAR POWER PLANTS. F. Cesari (CNEN, Rome). Energia Nucl. (Milan), 11: 137-57(Mar. 1964). (In Italian)

Some maximum credible accidents in power reactors and the relative primary and secondary effects were examined in order to single out the project conditions and the free volume of the container. In the second part, various types of containers were compared on the basis of some constructive requirements and of the results of a comparative economic enquiry carried out on boiling water reactors. (auth)

21648 THE DESIGN OF NUCLEAR POWER REACTORS WITH A UNIFORM THERMAL POWER DISTRIBUTION. Jeffery Lewins. Nucl. Energy, 99-104(Apr. 1964).

Economics of nuclear power are much improved if the distribution of thermal power within the core is uniform, thus allowing the reactor to be run at its maximum output throughout. The theory of such a uniform power design and the solutions in one- and two-group diffusion theory (with an extension to multigroup theory) are given. It is shown that the power output can be improved appreciably over that of the conventional flat-flux design while there are additional advantages of good dynamic control during burnup of fuel inherent in the flat power design. (auth)

21649 WYLFA. Nucl. Eng., 9: 119-20(Apr. 1964).

The design of the dual-reactor 1,180-Mw(e) Wylfa nuclear power station is discussed. The dry storage system for irradiated fuel and the proposed control system are described. Operation is scheduled by 1968. (R.E.U.)

21650 HUNTERSTON. Nucl. Eng., 9: 121-34(Apr. 1964).

The commissioning program, design and construction of the graphite core, the servicing machine, safety aspects, the reactor shield cooling system, and the charge tube storage equipment of the Hunterston reactor are described. (R.E.U.)

21651 REPORT ON ECONOMIC ANALYSIS FOR OYSTER CREEK NUCLEAR ELECTRIC GENERATING STATION. Nucl. News, 7: No. 4, 48p.(Apr. 1964).

Economic analyses of construction and operation of the Oyster Creek Nuclear Electric Generating Station are presented. The reactor is to be of the boiling water type with an expected capability of 640 Mw(e). Fossil fuel plant economics are compared to the Jersey Central Power and Light Company installation at Oyster Creek. (R.E.U.)

21652 CHEMICAL SHIM CONTROL FOR POWER REACTORS. P. Cohen and H. W. Graves, Jr. (Westing-

house Electric Corp., Pittsburgh). Nucleonics, 22: No. 5, 75-6; 78-82(May 1964).

The use of a neutron poison—e.g. boric acid—dissolved in primary coolant to control slowly varying reactivity effects is considered. Chemical shim provides increased power density and lowers control-rod requirements. The decrease of negative temperature coefficient does not appear to be a safety hazard or to limit fuel burnup. Studies on the Yankee and Saxton reactors indicate so far that problems in reactor functioning or safety from chemical and physical characteristics of boric-acid containing coolant are minimal. (M.J.T.)

21653 THE MANUFACTURE OF EGCR CORE I FUEL ASSEMBLIES. G. M. Tolson (Oak Ridge National Lab., Tenn.) and M. G. Arlotti. Welding J. (N. Y.), 43: 280-6 (Apr. 1964).

The entire initial core loading for the EGCR, 1650 fuel assemblies, was successfully produced by: copper brazing a mid-cluster or midplane spacer to empty fuel tubes under a hydrogen atmosphere; welding end caps to empty fuel tubes prior to loading them with UO_2 pellets; assembling individual fuel elements by sealing off each fuel tube after loading it with UO_2; and using welding and appropriate fixturing to produce individual fuel assemblies each consisting of seven precisely spaced fuel elements. (P.C.H.)

21654 DEFINITION AND CALCULATION OF EFFECTIVE CROSS SECTIONS FOR POWER REACTORS AND THEIR APPLICATION FOR CALCULATION OF BURN-UP. A. W. Eitz. Thesis, Aachen, Technische Hochschule, 1962. 159p. $2.00(Gmelin, AED-DISS. 62-676). (In German)

In calculations of burnup, small inaccuracies of the effective cross section can cause large deviations in the result. A method with simplified mathematical formulas is described for the calculation of relatively accurate values of the cross section using a digital computer. Dependence of cross sections on various parameters such as temperature and composition of the medium is given. A complete burnup calculation for the BR-3 reactor was made. (Gmelin Inst.)

21655 STAFFING OF THE ML-1 POWER PLANT WITH QUALIFIED SUPERVISORS AND OPERATORS. R. H. Chesworth (Aerojet-General Nucleonics, San Ramon, Calif.). 5p. (CONF-243-53)

From American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

The joint training and qualification program carried out for the ML-1 power plant is described. (C.E.S.)

21656 NUCLEAR POWER ECONOMICS. A METHOD OF SYSTEM ANALYSIS. Robert W. Kupp and Donald J. Sengstaken (Long Island Lighting Co., Hicksville, N. Y.). 11p. (CONF-187-122)

From American Nuclear Society Meeting, New York, Nov. 1963.

A method for analyzing nuclear power economics for comparison with fossil plants is described. The method accounts for the greater annual generation by the nuclear plant resulting from lower unit fuel cost and for the effect that future generating additions will have on its capacity factor. (C.E.S.)

21657 EXPERIENCE ON THE REMOVAL OF IMPURITIES FROM LIQUID METAL SYSTEMS BY COLD-TRAPPING. J. A. Bray. 25p. (CONF-467-5)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

Experience in impurity removal by cold-trapping, which was obtained on DFR and its associated liquid metal rigs, is reviewed. The development of the present DFR cold-trapping system is outlined, and the operation of the additional pumped loops, which were required in order to control the reactor impurity levels, are described. Operation of the liquid metal rigs ancillary to the reactor project is discussed with particular reference to the control of impurity levels. (auth)

21658 THE AUSTRALIAN HIGH TEMPERATURE GAS COOLED REACTOR FEASIBILITY STUDY. W. H. Roberts (Australian Atomic Energy Commission). 35p. (CONF-281-40)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The feasibility of a high-temperature CO_2-cooled, power reactor in which fissile and fertile materials are distributed as small particles in a matrix of beryllia is discussed. The study is concerned with pebble bed cores fueled with spheres composed of thorium oxide, plutonium oxide, and beryllium oxide. (C.E.S.)

21659 THE ROLE OF DISPERSED FUELS IN THE FURTHER DEVELOPMENT OF THE ADVANCED GAS COOLED REACTOR. H. Kronberger (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). 17p. (CONF-281-41)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The performance of dispersion fuels in the Windscale Advanced Gas Cooled Reactor is discussed. UO_2 dispersed in BeO and UC dispersed in SiC are considered. Reactor performance and economics are also discussed. (C.E.S.)

21660 ATTAINMENT OF SATISFACTORY PERFORMANCE OF BeO IN AN H.T.G.C. REACTOR. W. J. Wright (Australian Atomic Energy Commission). 24p. (CONF-281-25)

From International Conference on Beryllium Oxides, Sydney, Oct. 1963.

The properties of beryllia most pertinent to high temperature gas-cooled reactor design are summarized, and the relative advantages in improving these properties are discussed. Special attention is given to the processes whereby the improved properties are most likely to be attained at minimum cost. (P.C.H.)

21661 CHEMICAL EXPERIENCE WITH THE DOUNREAY FAST REACTOR. D. M. Donaldson. 39p. (CONF-467-1)

From European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963.

Impurities, particularly oxygen, in the liquid metal coolant of the Dounreay Fast Reactor are discussed in the light of information that has been amassed during the past two years. Probable sources of these impurities are considered and the resulting effects of their presence in the circuit, such as circuit blockage, corrosion of fuel and cladding material, and embrittlement of cladding material, are detailed and compared with data obtained in out-of-pile rigs. The correlation of these data are discussed at length, particularly with respect to the levels of oxide present in the reactor coolant. (auth)

21662 IMPROVED NUCLEAR POWER REACTOR. Alan Bell (to Foster Wheeler Ltd.). British Patent 954,542. Apr. 8, 1964. Filed Aug. 25, 1959.

A steam-cooled, heavy or light water moderated power reactor is designed. The fuel elements are disposed within

the inner tubes of coaxial tube pairs whose outer tubes at their upper ends are fed with saturated cooling steam and at their lower ends are closed so that steam passing through the annulus is passed into the inner tubes. Thus, either the inner tubes or the fuel elements can be easily withdrawn from the reactor, and all the steam connections are made at the upper end of the pressure vessel. The water moderator is preferably maintained at a pressure and temperature equal to that of the saturated cooling steam, thus minimizing the pressure and heat transfer problems. The reactor is controlled by regulating the moderator level in several vertical tubes within the moderator level. (D.L.C.)

21663 IMPROVEMENTS RELATING TO STEAM GENERATING EQUIPMENT. Terence Felix Thomas (to Associated Electrical Industries Ltd.). British Patent 954,630. Apr. 8, 1964. Filed July 22, 1959.

Means is designed for disposing of surplus steam in the steam generating equipment of a nuclear power plant. The means comprises an ejector condenser with a valve for supplying the nozzle with steam when the steam pressure exceeds a predetermined maximum, and a feed water system for supplying water to the ejector to be entrained into the steam jet, causing condensation of the steam. The condensate is returned to the feed water system, and means is provided for removing heat from the system. (D.L.C.)

21664 IMPROVEMENTS IN OR RELATING TO HIGH TEMPERATURE GAS COOLED REACTORS. Denis Victor Kinsey, Leon Jean Valette, and Johan Lothe (to United Kingdom Atomic Energy Authority). British Patent 954,718. Apr. 8, 1964. Filed Mar. 28, 1964.

A method is given for removing CO_2 and H_2O impurities from the purge gas before it contacts the fuel for fission product removal, in high-temperature gas-cooled reactors of the Dragon type. The method comprises locating a porous body of reactive graphite upstream in the purge gas circuit. The reactivity of the graphite body may be increased by addition of Ba or Sr oxides or a gettering metal material. Thus, the purge gas is prevented from corroding the fuel. (D.L.C.)

Process Heat Reactors

21665 NUCLEAR APPLICATIONS TO SALINE-WATER CONVERSION AND THEIR ECONOMIC IMPLICATIONS. S. Baron (Burns and Roe, Inc., New York). Nucl. News, 7: No. 4, 36-9(Apr. 1964).

The general design approach for application of nuclear energy to desalination of sea water is discussed. A survey is presented of nuclear desalination projects and studies. Technological problems, siting criteria, and reactor types are discussed in large-scale reactor development for desalination. (R.E.U.)

Propulsion and Space

Refer also to abstract 20603.

21666 (APL-TDR-64-27) BEARING TESTS FOR THE SPUR TURBOGENERATOR. (Garrett Corp. AiResearch Mfg. Div. of Arizona, Phoenix). Nov. 18, 1963. Contract AF33(657)-8954. 112p.

The results of the liquid-potassium journal-bearing test program for the SPUR turbogenerator are presented. The activities described include the design, assembly, and checkout of the bearing test rig, and the results of a successfully completed 250-hour endurance test on a hydrodynamic journal bearing using 600°F liquid potassium as the lubricant. Unidirectional loads from 6 to 25 pounds were applied to the bearing operating at a speed of 24,000 rpm. In general, the data for film thickness versus load; attitude angle versus eccentricity ratio, and the associated bearing stiffness correlates well with hydrodynamic theory discussed in Report ASD-TDR-63-833. (auth)

21667 (BAW-1280) THE CNSG II—A CONCEPTUAL MERCHANT SHIP NUCLEAR REACTOR DESIGN. (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Sept. 1963. Contract AT(30-1)-3206. 77p.

The Consolidated Nuclear Steam Generator II consists of a pressurized water reactor, a steam generator, and a pressurizer combined in a single pressure vessel. The design of the 66000 shaft horsepower system is presented, together with basic plant information for designs of 15000, 22000, and 30000 shaft horsepower. The economics, safety characteristics, and operational procedures of the plant are also discussed. (D.C.W.)

21668 (GEMP-274) 630A MARITIME NUCLEAR STEAM GENERATOR. Progress Report No. 7. (General Electric Co. Advanced Technology Services, Cincinnati). Mar. 16, 1964. Contract AT(40-1)-2847. 108p.

This progress report covers the period from November 15, 1963 to February 15, 1964. A study indicated that the most desirable type of blower drive turbine is one using main turbine throttle steam conditions and exhausting to the main turbine cross-over line. Preliminary planning for the initiation of a dynamic structural analyses of the overall steam generator was completed. External pressure loading and thermal stress calculations show that the calandria has a suitable design margin. A revised fuel latch operable from the rear face of the core was designed. A study was initiated to determine the feasibility of substituting Zircaloy for the stainless steel tubing within the active core. Preliminary sizing of control rod extensions and gang plates was completed. Initial loading of the second configuration of the 630A critical experiment reactor was completed. Detailed power distributions were measured in the 11 typical positions. Subcritical and critical rod worth curves were obtained in the critical experiment with up to 132 shim rods in the core. Moderator temperature coefficient measurements were made and agreed well with analytical data. Critical experiment correlation of fine radial power calculations in the revised mock-up showed good agreement. Performance specifications were prepared for a 1-Mw(e) power plant. Parametric thermal analyses, based on various tube sheet thicknesses and heating rates, were completed for the top and bottom tube sheets. The shield plug was redesigned to accommodate additional shim rods and to facilitate fabrication and moderator flow adjustments. Calculations of the operating and shutdown dose at the nuclear sensor location was started. Studies were performed to determine the size of the port openings needed to prevent buckling in the containment vessel in the event of ship sinking. A blower shaft static seal was built and tested with satisfactory results. Manufacture and procurement of all parts for two developmental dynamic rod actuators were completed. The two-tube boiler was modified and operated satisfactorily on automatic control down to 20 percent power. A reactor control system that meets response and accuracy requirements was simulated on the analog computer. Investigation of a possible test site for

power testing the prototype reactor was continued with cost estimates and a facility layout drawing being made for the IET facility at ITS. Specimen ORF-4 was removed from test after 4800 hours of actual operation at 1300°F, equivalent to approximately 15,000 hours of full-power 630A operation. An estimated 40 percent burnup of the ^{235}U atoms occurred. Creep tests on warm-finished fuel sheet have accumulated more than 12,000 hours at 630A stress and temperature conditions with no greater than 0.75 percent plastic creep. Cladding-stock creep tests have surpassed 15,000 hours at various combinations of stress and temperature with satisfactory results. (auth)

21669 (NAA-SR-9190) THE SNAPKIN VI COMPUTER PROGRAM FOR SNAP REACTOR KINETICS CALCULATIONS. W. A. Rhoades (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1964. Contract AT(11-1)-Gen-8. 106p.

The computer program SNAPKIN VI is described which solves the space-independent reactor kinetics equations with feedback equations representing the principal shutdown mechanisms in a SNAP reactor. Reflector delay effects are treated by a reflector group model. By using an alternate main program and two alternate subroutines, spatially dependent feedback effects may be considered. Printed, CRT, and punchcard output may be obtained optionally. Sample problems are demonstrated for both versions of the code. The equations and listings are included. (auth)

21670 (NAA-SR-Memo-9117) THE EFFECT OF A MINIMUM WEIGHT RADIAL REFLECTOR ON SNAP SHIELDING REQUIREMENTS. R. L. Bernick (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 17, 1963. Contract AT(11-1)-Gen-8. 6p.

A model was derived for a minimum-weight radial reflector for SNAP reactors. The effect, which the use of this optimal reflector has on radiation shield weight requirements is investigated. Weights of systems employing conventional and optimal radial reflectors are compared using the FARSE and FARSER computer codes. It is found that for the configuration under study additional shield weight required when the optimal reflector is used is in excess of the reflector weight savings. (auth)

21671 (NAA-SR-Memo-9232) DEVELOPMENT OF SALT VELOCITY TECHNIQUE. R. S. Daleas (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Nov. 15, 1963. Contract AT(11-1)-Gen-8. 36p.

The salt velocity technique for measuring coolant flow through a SNAP 8 tri-cusp channel was studied and developed. The parameters important in obtaining reproducible data were investigated and a test procedure, which yields data of good precision, was developed. Data were taken on a tri-cusp channel with flush circular electrodes (0.125 inch O.D.) as well as on a tri-cusp channel with parallel plate electrodes (0.006 inches thick, 0.250 inches long), which were situated 0.050 inches apart and protruded 0.040 inches into the stream. The data are presented as the ratio of U_{exp}/U_{avg} where U_{avg} is calculated by means of a flowrator and channel geometry. It was found that in the tri-cusp channel for a range of Reynolds Numbers of 11,000 to 25,000, a radial velocity profile could not be sensed. The peripheral velocity profile over the central half of the channel appeared to be flat and relatively independent of the Reynolds Number. The data were compared with similar work of Palmer and Swanson in a qualitative and quantitative manner. Reasons are given for using a single calibration factor in the hydraulic model testing of S8DS core. While some slight modifications should be made to further improve the accuracy of the salt velocity procedure, the most important phases of the development and perfection of the procedures were accomplished successfully. (auth)

21672 (NAA-SR-Memo-9507) HERMETIC SEALING PROBLEMS IN A SMALL BOILING WATER REACTOR. G. O. Haroldsen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 12, 1964. Contract AT(11-1)-Gen-8. 35p.

The results of an extensive survey of the literature and of the subsequent analysis permit the prediction of the rate of radiolytic decomposition of the water coolant. Due to the difficulty in assessing the rate of the back reactions, fundamental data from water radiation chemistry could not be applied in a straightforward manner. It proved more expedient to employ the actually observed decomposition rate data from other boiling water reactors and to extrapolate to the operating conditions of SNAP 4. By this approach, the water decomposition rate was estimated to be 5 lbs/day. To assure adequate capacity under all conditions, the catalyst bed was sized to handle twice this rate. Based on the design method of Garber and Peebles, a catalyst bed 3 inches in diameter by 12 inches long, consisting of platinum-coated alumina pellets, appears ample. Operation of the recombiner in a closed recirculatory system was analyzed. It appears that an excess of hydrogen will result as oxygen is preferentially consumed in the initial corrosion process (metal oxidation). Once a stable oxide film is established on the stainless steel surfaces and the excess hydrogen is drawn from the system, the recombiner can thereafter handle the radiolytic gases satisfactorily. (auth)

21673 (NAA-SR-Memo-9576) ANALYSIS OF SNAP REACTOR COOLANT CROSS-FLOW IN THE SNAP-2 REACTOR EXCLUDING THE PERIPHERAL "UNFED" CHANNEL. Thermo-Physics Technical Note No. 30. L. D. Montgomery (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 20, 1964. Contract AT(11-1)-Gen-8. 16p.

The deviation from the expected coolant flow distribution within the SNAP 2 reactor is due to the filling and draining of the "unfed" peripheral flow channels. An analysis of the cross-flow in a simulated SNAP 2 model omitting the "unfed" peripheral channels was made. The results of this investigation are presented herein. (auth)

21674 (NASA-TN-D-2157) LUNAR MISSION PERFORMANCE EVALUATION PROCEDURE FOR ORBIT-LAUNCHED NUCLEAR VEHICLES. Robert E. Austin and George B. Kearns (National Aeronautics and Space Administration. George C. Marshall Space Flight Center, Huntsville, Ala.). Apr. 1964. 47p.

An estimation procedure is described and reference data are presented by which the influence of certain design parameters and lunar mission velocity requirements can be determined for orbit-launched nuclear vehicles. The procedure provides a rapid, unsophisticated method of calculating the performance of nuclear propulsion systems for specific lunar mission profiles. The performance parameters considered are: payload ratio, characteristic velocity requirement, propellant ratio, flight path angle, central angle, burning time, and injection altitude. The effects of initial thrust-to-weight ratio, specific impulse, lunar transfer time, and initial orbital altitude are also

considered. The range of specific impulse assumed is restricted to that considered practical for nuclear heat exchanger propulsion systems. Application of the procedure is demonstrated by numerical examples. The results of these and other examples are compared with exact computer solutions and are shown to be well within the accuracy usually required in preliminary design studies. (auth)

21675 (NP-13795) SUNFLOWER SOLAR RANKINE SYSTEM. MERCURY CORROSION AND CORROSION PRODUCT SEPARATOR STATUS SUMMARY. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Apr. 16, 1963. 41p. (ER-5302)

The design and development history of the Thompson Ramo Wooldridge Test Rig, which was built primarily for conducting checkout and performance type testing of the Sunflower Rankine system components, are given. Tests were also performed for the SNAP 2 and SPUD programs. Studies were conducted on material resistance to corrosion, time-temperature parameters, corrosion product removal, inhibitors, and wetting agents. Designs of the corrosion product separator and Sunflower Test Rig are shown. Mercury corrosion data are included for Haynes-25 and molybdenum steel. (L.B.S.)

21676 (SSD-TDR-63-217) A GENERALIZED SHIELDING STUDY FOR NUCLEAR ELECTRIC SPACE POWER PLANTS. E. R. Berry (Aerospace Corp., El Segundo, Calif.). Aug. 28, 1963. Contract AF04(695)-169. 42p. (AD-418121; TDR-169(3560-20)TN-1).

The weights and thicknesses of two-layer W–LiH shadow shields were calculated for SNAP-2, -8, and (assumed) -50 reactors. The shields are shaped as spherical sectors with half-angles up to 30° and are sized so that no part of the reactor is visible within the volume subtended by the shield. Weights and thicknesses are presented for both manned and unmanned vehicles over a wide range of reactor thermal powers, operating durations, reactor-payload separation distances, and allowable radiation dosages. The thicknesses of the W and LiH layers are optimized to provide a minimum weight shield. (auth)

21677 (TID-20552) A 1000 HOUR TEST OF A CORROSION PRODUCT SEPARATOR UNIT IN A HAYNES ALLOY NO. 25 LOOP CONTAINING MERCURY—TEST G-16. James F. Nejedlik (Thompson Ramo Wooldridge Inc., Cleveland). Mar. 9, 1962. Contract AT(11-1)-Gen-8. 29p. (TM-3388-67)

One of the major unsolved problems affecting the life of the SNAP II Power Conversion System is the mass transfer of corrosion products by mercury and subsequent deposition. It is feared that the corrosion products might tend to accumulate in critical areas such as orifices, bearings and so forth. Therefore, this test was conducted to evaluate a corrosion product separator and to determine the influence of corrosion product removal on corrosion rate. The corrosion product separator was successful in removing 85 percent of the elements corroded from the container walls. The loop and separator, both fabricated from Haynes alloy No. 25, operated for 1000 hours. The mercury was boiled and condensed at 1100°F, superheated to 1190°F and subcooled to 325°F. The flow rate in this loop was much higher than in previous loops, being approximately 37 pounds of mercury per hour as contrasted with approximately 12 pounds of mercury per hour. No increase in corrosion rate was noticed as a result of the higher flow rates and velocity or by the removal of corrosion products. If this type of separator or an improved type works equally as well in the final application, the danger of failure from corrosion products should be greatly reduced. (auth)

21678 REQUIREMENTS AND PROSPECTS OF NUCLEAR PROPULSION SYSTEMS FOR SPACE VEHICLES. W. Peschka (DVL-Institut für Raumfahrtforschung, Porz, Ger.). Atomwirtschaft, 9: 117-20(Mar. 1964). (In German)

Rockets, to be suitable for space flight, must be able to attain terminal velocities of 11 km/sec. Further, the useful load relative to the take-off weight must be as large as possible. High terminal velocities demand high exit velocities for the drive material as well as large mass ratios. Since the rise in terminal velocity obtained by increasing the mass ratio becomes smaller as the mass ratio increases it is necessary to find propulsion units that produce high exit velocities with high thrust. The liberated energy is about 10^6 times greater with nuclear propulsion units than with chemical reactions. The distinction between a nuclear and a chemical propulsion unit lies only in the fact that, with the former type, the thermal energy of the drive material is supplied from outside. The thermal energy can be transferred by convection or by radiation. In the case of convective heat transfer a nuclear reactor replaces the burning chamber of a chemical propulsion unit. Propulsion reactors must possess very high loadings, e.g., a mass throughput of 500 kg/sec requires a reactor power of 20,000 Mw. The upper limit is likely to lie at about 100,000 Mw. Technological problems appears because of the stringent demands on the fuel elements. The required materials must not only resist high temperatures and be stable against hydrogen-induced corrosion but must also possess suitable nuclear properties. Propulsion reactors with solid fuel elements are already undergoing tests. Reactors with liquid or gaseous phase fuel elements have many design problems. Chemical and nuclear stages are compared in tables and illustrations. The comparison indicates the superiority of nuclear propulsion. (auth)

21679 TURBOMACHINERY CHARACTERISTICS OF BRAYTON-CYCLE SPACE-POWER-GENERATION SYSTEMS. Milton G. Kofskey and Arthur J. Glassman (Lewis Research Center, Cleveland). New York, American Society of Mechanical Engineers, 1964, Preprint Paper 64-GTP-23, 15p, $1.00. (CONF-465-1)

From American Society of Mechanical Engineers Gas Turbine Conference and Products Show, Houston, Mar. 1964.

The results of an analytical study of turbomachinery requirements and configurations for Brayton-cycle space-power systems are presented. Basic turbomachinery requirements are defined and typical effects of such system design parameters as power, temperature, pressure, and working fluid on turbomachinery geometry and performance are explored. Typical turbomachinery configurations are then presented for systems with power outputs of 10, 100, and 1000 kw. (auth)

21680 FACILITY DESIGN PROBLEMS ASSOCIATED WITH STATIC FIRING OF LARGE NUCLEAR ROCKET STAGES. Maxwell R. Morton (Vitro Engineering Co., New York). 37p. (CONF-187-117)

From American Nuclear Society Meeting, New York, Nov. 1963.

The problems associated with the facilities required to fabricate, assemble, checkout, test, and evaluate large nuclear rocket stages are discussed. Site evaluation and the maximum credible accident are considered. Facility

components and static test site limitations for operation at various power levels are described. (C.E.S.)

Research and Test Reactors

21681 (HW-80680) DESIGN TEST 1172—THERMAL AND BENDING TEST OF GRAYLOC CONNECTION FOR ARCO ATR GAS LOOP. K. G. Hawkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 13, 1964. Contract AT(45-1)-1350. 11p.

The ability of a modified Grayloc connector to contain He at pressure and temperature was tested, since such connectors will be welded to a stainless steel tube containing He at 280 psi and 600°F. The connector was cyclically subjected to a bending moment of 400 ft-lb, heated to 600°F as the bending moment was removed, vibrated at 270 cpm at 600°F, and cooled to 200°F as bending moment was reapplied. The results are discussed. (D.C.W.)

21682 (IDO-16871-2) FUNDAMENTALS IN THE OPERATION OF NUCLEAR TEST REACTORS. VOLUME 2. MATERIALS TESTING REACTOR DESIGN AND OPERATION. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Oct. 1963. Contract AT(10-1)-205. 175p.

The reactor components, building, control system and circuitry, and experimental and handling facilities are described and discussed, together with operation, shutdown, tank work and supplemental facilities. Training questions and answers are included. (D.C.W.)

21683 (ANL-Trans-9) PHYSICAL CHARACTERISTICS OF THE BR-5 REACTOR. A. I. Leypunskii, O. D. Kazachkovskii, A. I. Abramov, et al. Translated by Elmar K. Wilip (Argonne National Lab.), from p.315-34 of "Proceedings of the IAEA Seminar on the Physics of Fast and Intermediate Reactors, held in Vienna, August 3-11, 1961." 22p.

The Br-5 reactor is an experimental fast reactor (5 Mw thermal) using plutonium oxide fuel and sodium coolant. The reactor's reflector consists of a thin layer of natural uranium surrounded by a thick layer of nickel. The physical features of the reactor as measured during start-up and operation are described. The neutron flux at the center of the core is 8.2×10^{14} n/cm^2 s. The results of studies of the reactor's kinetics, its temperature and power coefficients, and the distribution of the number of fissions and reaction rates of various reactions over the core volume are presented. Neutron fluxes and spectra were also measured in the reactor's experimental assemblies. (auth)

21684 EFFECT OF SLIGHT SHIFT OF FUEL ELEMENTS ON THE REACTIVITY OF UTR-B. Katsuichi Nakamura, Hidebumi Shimizu, Hiroshi Tanaka, and Takeo Niwa (Kinki Univ., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 129-34(Mar. 1964). (In Japanese)

The core-tank of UTR-B is separated in six sections. Each section has a length of 83.3 mm in east-west direction, and holds a fuel element that has a length of 76.2 mm in the same east-west direction. It may be expected that the reactivity of the reactor would be changed, if each fuel element is shifted towards the center line of the core-tank or in the opposite direction. The possible reactivity change due to the slight shift of the fuel elements was examined. It was found that if each fuel element is shifted toward the center line of the core-tank, the reactivity of the reactor increases and the critical mass decreases. If each fuel element is shifted outward in the opposite direction, the reactivity of the reactor decreases and the critical mass increases. This effect is smallest near the center line of the core-tank, and the farther the position is off the center line, the larger the effect becomes. But near the side of the core-tank, the effect comes small again. This may be affected by the thermal neutron flux distribution and the importance function. The thermal neutron flux distribution in the core-tank was measured, and the importance function was calculated. The curve of the statistical weight vs position of the core-tank was found to have the same tendency as the experimental results. (auth)

21685 PREDICTING EXCESS REACTIVITY IN THE ETR AS A FUNCTION OF POWER-TIME. J. W. Henscheid and E. E. Burdick (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Sci. Eng., 19: 39-47(May 1964).

A semiempirical equation is used to predict excess reactivity in the ETR as a function of power-time in terms of reactivity parameters that are routinely measured in a mockup of each ETR core in the ETR Critical Facility. Constants in the equation were evaluated by fitting the equation to plots of excess reactivity as a function of power-time obtained for several cores in the ETR. The equation and reactivity measurements fulfill the need for frequent and reliable predictions of core charge life as well as control-rod positions during reactor operation. (auth)

21686 THE CONTROL AND INSTRUMENTATION OF THE SOUTH AFRICAN RESEARCH REACTOR. C. Moeller (South African Atomic Energy Board, Pretoria) and P. J. Joubert. S. African Mech. Engr., 12: 126-43(Dec. 1962).

The nuclear and process instrumentation designed for the South African research reactor, Safari I, is described. (C.E.S.)

21687 EXTENDING REACTOR TIME-TO-POISON AND REDUCING POISON SHUTDOWN TIME BY PRE-SHUTDOWN POWER ALTERATIONS. Edward Kerr (Atomic Energy of Canada Ltd., Chalk River, Ont.). 11p. (CONF-243-51)

From American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

Manipulation of reactor power prior to shutdown and increasing the time-to-poison a sufficient amount to enable the required maintenance work to be completed and the reactor immediately restarted are discussed. The method employed in the NRU Reactor to gain the maximum time-to-poison with the least production loss is outlined. The method is based on intuition and is described by means of an analog of the iodine–xenon equations rather than the equations themselves. (C.E.S.)

21688 DESIGN AND OPERATION OF AN INEXPENSIVE COOLING SYSTEM FOR A POOL REACTOR. H. J. Worsham, Jr. (Babcock and Wilcox Co., Lynchburg, Va.). 33p. (CONF-243-52)

From American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963.

The design and operation of a cooling system for the Lynchburg Pool Reactor are discussed. Jets of water are pumped upward toward the fuel elements transferring momentum to the coolant within the elements. This arrangement gives an effective multiplication in flow rate and allows the use of a smaller, less expensive pump. (C.E.S.)

21689 THE SUB-CRITICAL ASSEMBLY IN A SMALL UNIVERSITY. F. A. Anderson (Univ. of Mississippi,

Oxford). New York, American Inst. of Chemical Engineers, 1964, Preprint 13e, 9p, $0.50. (CONF-393-2)

From American Institute of Chemical Engineers Symposium on Techniques at High Pressures, Memphis, Feb. 1964.

The design and teaching applications of a subcritical assembly for universities are discussed. (C.E.S.)

21690 DEVICE FOR ADJUSTING THE POSITION OF ELEMENTS, ESPECIALLY IN A NUCLEAR REACTOR TANK. Jacques Jouin (to Commissariat à l'Energie Atomique). British Patent 954,474. Apr. 8, 1964. Priority date Apr. 13, 1962, France.

A simple device was designed for positioning and adjusting fuel elements or reflector elements inside the tank of a swimming-pool reactor. The device permits the arrangement of elements in a uniform lattice (square, rectangular, or triangular) with any pitch desired. The operation of the device is described. (D.L.C.)

WASTE DISPOSAL AND PROCESSING

21691 (HW-77163) CGC-981 PROCESS DESIGN ENGINEERING WASTE MANAGEMENT PROGRAM — PHASE II. H. L. Caudill, H. D. Haberman, and J. W. Kolb (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 31, 1963. Contract AT(45-1)-1350. 98p.

Phase II of the Waste Management Program involves a demonstration of a process system for packaging the long-lived fission products as a concentrated, low-volume waste. The process includes precipitating Cs in the feed solution, adsorbing and immobilizing the Cs and/or Sr on inorganic zeolite ion-exchange resin in containers, sealing the containers, and routing the process raffinates to the waste tank farm complex. The process engineering work includes the construction of a packaging cell, modifications of building air exhaust system, and relocation and modification of existing process vessels. (D.L.C.)

21692 EXPERIENCES IN THE TREATMENT OF LOW-LEVEL RADIOACTIVE EFFLUENTS IN THE KERNFORSCHUNGSZENTRUM, KARLSRUHE DURING 1961 AND 1962. H. Krause (Kernforschungszentrum, Karlsruhe, Ger.). Kerntechnik, 6: 97-104(Mar. 1964). (In German)

Decontamination facilities are described and results from the first two years of operation are presented. Decontamination factors of 5 were reached in the treatment of low level radioactive laboratory effluents by chemical precipitation. In this case the ratio of sludge to decontaminated water was 1:120. Slightly higher active waters were treated by ion exchange. The decontamination factor reached now an average of 30 while the volume reduction ratio was 1:80. The regeneration waters from the ion exchangers were concentrated together with certain laboratory effluents in raising film evaporator yielding a solution of 40% which was then fixed on concrete. The total amount of radioactive effluents treated was 5300 m^3. (auth)

21693 PROCEEDINGS OF THE SEVENTEENTH INDUSTRIAL WASTE CONFERENCE, MAY 1, 2, AND 3, 1962. Engineering Extension Series No. 112. Purdue Univ., Eng. Bull., Ext. Ser., No. 112, 1-878(Mar. 1963). Lafayette, Ind., Purdue University, 1963. 878p.

Separate abstracts were prepared for two papers presented at this conference. Other papers cover various aspects of industrial waste processing. (C.H.)

For abstracts of individual papers see: 21694 and 21695.

21694 NEW DEVELOPMENTS IN THE MANAGEMENT OF LOW- AND INTERMEDIATE-LEVEL RADIOACTIVE WASTES. Harold Bernard (Atomic Energy Commission, Washington, D. C.). Purdue Univ., Eng. Bull., Ext. Ser., No. 112, 389-408(Mar. 1963).

Recent developments in the treatment of low- and intermediate-level radioactive wastes are reviewed. It is pointed out that such wastes are usually associated with large volumes of water and that treatment techniques should remove hazardous radionuclides simultaneously with the more abundant stable chemicals or have a specificity for the hazardous radionuclides in spite of the presence of stable constituents. Examples of waste treatment facilities described include a chemical treatment plant at Oak Ridge National Laboratory that consists of a lime-soda ash water softening plant with clay added to scavenge the Ce from the water while the parent process removes Sr and the disposal of large volumes of radioactive effluent into the ground through a pond and well at the National Reactor Testing Station. The monitoring of both systems is discussed. Research studies on ion exchange technology, recycling effluent to the process plant, mineral exchange between fission products and natural minerals, foam separation, deep underground disposal, the use of the Higgins Contactor, evaporation and sludge storage, and freeze clarification are reviewed. (C.H.)

21695 RADIOACTIVE WASTE WATER DISTILLATION DATA AND COSTS. R. Rupert Kountz (Pennsylvania State Univ., University Park). Purdue Univ., Eng. Bull., Ext. Ser., No. 112, 409-20(Mar. 1963).

The performance of an evaporator for the purification of radioactive waste waters of varying concentrations of solids, varying acidity, and varying radioactivity was tested. Results indicated that distillation of radioactive waste water at low pressures and low temperatures produces water that is safe for general use. The estimated cost is between $0.20 and $0.50/gal. (C.H.)

21696 PRELIMINARY STUDY ON THE BEHAVIOR OF CLAY MATERIALS PASSING RADIOACTIVE SOLUTIONS. Guido Branca, Giuseppe Lenzi, and Renato Sinno (Università, Naples). Rend. Acad. Sci. Fis. Mat., Soc. Nazl. Sci. Napoli, (4), 29: 259-84(1962). (RT/PROT(63)12). (In Italian)

The possibility of making use of a montmorillonitic flegrea pozzuolana was examined for the decontamination of radioactive liquid wastes. The ^{90}Sr distribution coefficient of clay material was studied with regard to the particle size and to the moisture. Furthermore, the removal of such nuclide was determined depending on flow rate in the column. Afterwards the ion exchange capacity of the montmorillonitic component of pozzuolana was measured; thus the absorption mechanism interpretation is given and the occupied position of ^{90}Sr in the lattice defined on the basis of the results obtained by the x-ray data and the thermic-differential analysis. (auth)

21697 THE CLINCH RIVER STUDY: AN INVESTIGATION OF THE FATE OF RADIO-NUCLIDES RELEASED TO A SURFACE STREAM. R. J. Pickering, P. H. Carrigan, Jr., and F. L. Parker (Oak Ridge National Lab., Tenn.). New York, American Inst. of Chemical Engineers, 1964, Preprint 18e, 34p, $0.50. (CONF-393-3)

From American Institute of Chemical Engineers Symposium on Techniques at High Pressures, Memphis, Feb. 1964.

The Clinch River Study is a multi-agency effort to evaluate the physical, chemical, and biological effects of the release to the Clinch River of low-level radioactive wastes from the Oak Ridge National Laboratory. The major radionuclides released are ruthenium-106, cesium-137, cobalt-60, and strontium-90. Hydrologic and biologic studies indicated that radiation dosages known to result or assumed to result from direct and indirect means of exposure are below maximum permissible levels. Radionuclide concentrations in river water were measured at seven sampling stations on the Clinch and Tennessee Rivers. Mass balance calculations for 44 weeks of sampling indicate that losses of radionuclides from the water phase to river bottom

sediments represent only a very small portion of the total radioactivity released to the river. A study of Clinch River bottom sediment cores collected in 1962 disclosed a recurring pattern of variation in radioactivity with depth, which may reflect past events in waste disposal operations at the laboratory. Current investigations are expected to provide information about the chemical forms in which the major radionuclides exist and the mechanisms by which they were incorporated in the sediments. (auth)

GENERAL AND MISCELLANEOUS

21698 (ANL-6860) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, FEBRUATY 1964. (Argonne National Lab., Ill.). Mar. 15, 1964. Contract W-31-109-eng-38. 111p.

Research progress on the BORAX-V, general fast-reactor physics for liquid-metal-cooled reactors, fuel development, fuel reprocessing development, sodium coolant chemistry, the EBR-II, the FARET, experimental reactor and nuclear physics, theoretical reactor physics, high-temperature materials development, engineering mechanics, heat engineering, chemical separations, plutonium recycle program, the Argonne Advanced Research Reactor, the Rocket Fuel Test Reactor, magnetohydrodynamics, regenerative EMF cells, and nuclear safety is reported. (M.C.G.)

21699 (BNL-7841) COMPUTER-CENTERED DATA HANDLING SYSTEMS. R. J. Spinrad (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 12p. (CONF-182-9)

From the 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1964.

The advantages and disadvantages of a stored-program digital computer as a data gathering, analyzing, and control tool for experimental research, are outlined. The advantages of computers in high-energy, low-energy, and neutron physics research are listed. A survey is presented of the applications of computers in multiparameter analysis, concurrent data reduction, and multi-experiment research, with examples of each application. Effects of computer use on research techniques are discussed. (D.L.C.)

21700 (BNL-7855) MANGANESE, MELANINS AND THE EXTRAPYRAMIDAL SYSTEM. [G. C.] Cotzias (Brookhaven National Lab., Upton, N. Y.). [Feb. 24, 1964]. Contract [AT(30-2)-Gen-16]. 8p. (CONF-442-1)

From the Parkinson Symposium, Washington, D. C., Nov. 1963.

The role of Mn in the formation of melanins, the effects of cerebral melanins on nervous response, the enzyme and hormonal control of melanogenesis, and the development of extrapyramidal syndromes by mammals following Mn exposure are discussed. It is pointed out that a review of the literature relative to the evolution of cerebral melanins in primates shows that pigmentation increases as the relation of primates to man becomes closer. (C.H.)

21701 (BNL-7925) A COMPARISON OF THE CELL GENERATIVE CYCLE IN NORMAL, HYPERPLASTIC AND NEOPLASTIC MAMMARY GLAND OF THE C3H MOUSE. Francesco Bresciani (Brookhaven National Lab., Upton, N. Y. and Naples. Universita. Istituto di Patologie Generale). [1964]. Contract AT-30-2-GEN-16. 19p. (CONF-456-2)

From 18th Annual Symposium on Fundamental Cancer Research and Cellular Radiation Biology, Houston, Tex., Mar. 1964.

The duration of the cell generative cycle is reduced in tumors of the mammary gland in comparison to normal alveolar cells and this, in all probability, plays a role in the dynamics of neoplastic growth. The hyperplastic preneoplastic cells show a generation time intermediate between those of normal and tumor cells. Factors other than an increased generative cycle rate are not excluded by these results. The duration of both the DNA synthetic period and the post-mitotic presynthetic period and possibly the post-synthetic premitotic period and mitosis decrease in neoplastic cells and in normal cells under hormonal stimulation. This result points out that the control of the cell cycle rate does not depend exclusively on variation of G_1. In fact, hormones as well as neoplastic transformation seem to act via a general mechanism that affects equally biochemical processes in the different phases of the cycle. (auth)

21702 (BNL-7971) STUDIES ON THE ROLE OF SALT AND GENETICS IN HYPERTENSION. Lewis K. Dahl (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 28p. (CONF-494-1)

From Academy of Medicine of New Jersey Symposium on Diet and Heart Disease, New Brunswick, N. J., Apr. 1964.

Experimental and clinical data are reviewed that implicate genetic sensitivity to chronic excess NaCl ingestion as a cause of high blood pressure. Data on salt intake of populations from throughout the world are correlated with the prevalence of hypertension in the group. The prevalence of hypertension was greatest in groups with the highest average salt intake. Data on the incidence of hypertension in several thousand rats of several strains chronically fed additional salt indicate a genetic control of salt-induced hypertension and show that hypertension developing after salt feeding is usually permanent. It is postulated that genetic factors also control the induction of salt-induced hypertension in man. (C.H.)

21703 (CONF-296-4) TECHNIQUES FOR STUDYING APPEARANCE POTENTIALS (RPD) AND ION-MOLECULE REACTIONS WITH THE BENDIX (TOF) MASS SPECTROMETER. Charles E. Melton and William H. Hamill (University of Notre Dame, Notre Dame, Ind.). [nd]. Contract [AT(11-1)-427]. 43p.

From the Symposium on Unimolecular Reactions in the Mass Spectrometer and Related Topics in Chemical Kinetics, Salt Lake City, July 1963.

It is shown that the retarding potential difference (RPD) method for studying appearance potentials can be applied to the time-of-flight (TOF) mass spectrometer by making small changes. These changes and the RPD principle are discussed. Examples of ionization efficiency curves are given. A brief discussion is given of ion-molecule reactions as studied by the TOF instrument. Mass spectra taken at elevated pressures are given. (D.L.C.)

21704 (HW-SA-3028) HUMAN RESPONSE RELATED TO MEASURED SOUND PRESSURE LEVELS FROM ULTRASONIC DEVICES. C. P. Skillern (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 10, 1963. Contract AT(45-1)-1350. 23p. (CONF-84-3)

From American Industrial Health Conference, Cincinnati, May 1963.

An investigation was conducted to correlate subjective human response to the sound pressure levels produced by ultrasonic devices. Since little experimental information was available with respect to possible effects on the human ear, it was desired to obtain more with regard to noise levels and human response. The resulting information could be used as a guide for evaluating noise levels where ultrasonic devices might be used safely, and in the desirability for noise control. Noise levels up to 40,000 cps were

measured with a Brüel and Kjaer audio frequency spectrometer (Type 2109) and recorder in third octaves starting at 10,000 cps. The results indicate that at or above 90 db individuals give a subjective response. A summary of individual response compared to noise levels is shown. (auth)

21705 (IITRI-1184-12) MAGNETIC PROPERTIES OF INSULATORS. Quarterly Report No. 12, November 16, 1963–February 15, 1964. J. J. Markham (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Mar. 5, 1964. Contract AT(11-1)-587. 31p.

The saturated region of the EPR (electron paramagnetic resonance) spectrum of F-centers in KCl produced at 4°K by r-f fields smaller than those used previously was approximately as wide as that produced at higher powers. Preliminary results indicated a shift in the position of the saturated region during saturation before equilibrium with the microwave field was achieved. The saturated susceptibility was not consistent with a theory based on saturation of spin packets. A perturbation expansion of the eigenvalues of a Hamiltonian containing spin-orbit coupling involving several force centers, is shown to be gauge invariant to a second order in the perturbation parameters. It is also shown that the gauge invariance of the perturbation expansion is independent of the force centers involved in the spin-orbit coupling. The parameters defining the F-band in KCl were compared in crystals prepared by different methods over five years. Analyses for impurities are reported and it was concluded that the values reported earlier for the F-band are correct and the F-band width is not changed by improved purification methods. The band shape of the luminescent emission of the F-band in RbCl is being measured. The results on the short wavelength side at 78°K are reported for an additively colored crystal. This was compared with the data on absorption. (auth)

21706 (KR-66) QUARTERLY PROGRESS REPORT, OCTOBER–DECEMBER 1963. (Norway. Institutt for Atomenergi, Kjeller). Feb. 1964. 34p.

Operation and development of reactors and nuclear processes in Norway are reviewed. Information is included on: the operation of JEEP and NORA reactors, development of JEEP-II, fuel element development for Halden Boiling Reactor, fission of californium-252, gamma radiation studies, preparation and properties of ammonia-precipitated and sintered uranium dioxide, tensile properties of annealed and cold-worked stainless steel tubes, oxidation of aluminum alloys by 315°C water, corrosion of steel by ammoniated and pure water at 230 and 315°C, reprocessing of irradiated fuels, and production and use of radioisotopes. (N.W.R.)

21707 (MLM-1177) MOUND LABORATORY PROGRESS REPORT FOR OCTOBER, 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Oct. 31, 1963. Contract AT(33-1)-Gen-53. 27p.

Two flexible, conductive polysulfide-epoxy adhesives were evaluated. Both formulations were filled with carbon black and silver. The specific resistivities of the cured formulations remained at approximately 0.1 ohm-centimeter during a test period of three months. When the samples were heated to 160°F for six hours, the resistivities increased irreversibly; therefore, these formulations would be unsatisfactory for use above 160°F. The tensile strength for three conductive silicone adhesives was below the strength of comparable polyurethane adhesives. Ion exchange separations of rare earth elements are being investigated for the purification of promethium. Neodymium, used as a substitute for promethium, was separated from samarium. Two methods, elution with either hydrochloric acid or alpha-hydroxy-isobutyrate seemed promising. Eighteen power measurements were added to the half life calculations for the calorimetric $^{208}Po/^{209}Po$ half life sample. The most probable half lives increased from 1052.38 to 1053.50 days for ^{208}Po, and 13.05 to 16.11 years for ^{209}Po. The number of internal probable errors also increased from 4.75 to 8.16, an unusually high value, which is based on 100-year half life. Power measurements will be continued in order to confirm a band-spectra measurement indicating 15.5 ± 3 mass % ^{209}Po in the sample. ^{234}U was separated from aged ^{238}Pu solutions by ion exchange and solvent extraction techniques. The ratio of mass 234/238 in the sample was determined by mass spectrography to be 63.5. The determination of uranium in plutonium is being investigated by controlled potential coulometry and a spectrophotometric method in which the color is developed with 4-(2 pyridylazo) resorcinol (PAR). Quantitative results were obtained by controlled potential coulometry with five milligrams of uranium. Beer's law was followed from 0 to 300 micrograms of uranium complexed with PAR. In a five-month study the half life of ^{238}Pu was determined calorimetrically to be 87.5 ± 0.3 years, rather than the currently accepted value of 86.4 years. Potassium plutonium sulfate dihydrate is being studied as a potential primary calorimetric standard for plutonium. An equation was developed for $K_4Pu(SO_4)_4 \cdot 2H_2O$ solubility, which is affected by the formation of various sulfatoplutonate complexes. A 30-gram sample was prepared and is being analyzed by mass spectrometry, alpha counting techniques, and calorimetry. A six-stage cascade system of six hot-wire columns and two concentric-tube columns for the separation of ^{13}C from neutral methane is approaching steady state. The enrichment of gas from the middle of the sixth stage increased to 66% ^{13}C in the total carbon in 85% methane. Complete static thermal diffusion data were obtained for carbon monoxide with various carbon isotopes; the column, 24 ft long with a $\frac{3}{4}$-in. ID, contains a $\frac{1}{16}$-in. hot wire at 500°C. The data were analyzed statistically to find ratios of the coefficients in the isotope transport equation. Curves were drawn from a combination of theoretical tray requirements and height-equivalent-theoretical-plate (HETP) data. With these curves the actual required column length can be selected for any given recovery of ^{13}C from carbon monoxide feed. The time required for a column to reach steady-state operation can be reduced by one method with the use of a tapered column. A second method employs a straight column of the size required by reflux ratio considerations; a higher than normal boil-up is used, and the feed is introduced at progressively higher points in the column. An eight-column, four-stage, hot-wire thermal diffusion unit was used in an overlap arrangement between columns; fission xenon was used as feed to deplete the ^{131}Xe content. ^{131}Xe was reduced to 1.7% in the final product. ^{85}Kr is being separated from xenon by gas chromatography. In three experiments the ratios of xenon in the feed to xenon in the trap were 1701, 971, and 752. A detailed investigation of Van der Waerden's Trennschaukel theory uncovered an error in the determination of the relaxation time. The necessary equations were derived for an asymmetrical coefficient matrix and will be solved by a computer. Collision integrals are being calculated for a generalized potential function of the following form: $(r) = Ae^{-ar} - Ce^{-cr} - B_1r^{-6} - B_2r^{-8} - B_3r^{-10}$. An experiment to measure the thermal diffusion factor over the temperature range of 10 to 250°K is being performed using a two-bulb apparatus. The preliminary design for the two-bulb apparatus is complete. Cor-

rections are being calculated for the final gas composition to compensate for the gas in the tube which connects the two bulbs. The neutron growth rate for a one-gram Pu–Be source was calculated to be 1.1% per year with a standard error of 0.4% per year. Two Pu–Be sources were newly fabricated, and 18 recanned Pu–Be sources were returned to their users. Alpha source windows are destroyed by direct contact with appreciable amounts of polonium as a result of damage by recoil fragments from alpha decay. Four one-curie polonium alpha sources were fabricated on September 20, 1963. The windows were gold or stainless steel, and the distance of the window from the polonium deposit was varied. The sources were stored separately for periodic wipe checks for leakage. On October 15, 1963, all four sources were wipe free. The test was continued. Techniques are being developed for the fabrication of large-area, high-specific-activity, plated alpha sources. These sources will have a minimum activity of one curie per square centimeter; they must retain 95% of their activity over one or two polonium half lives. A vacuum system was completed for the analysis of gas samples containing as little at 5×10^{-13} mole per cent tritium. The precision for an analysis (which requires four hours) of 10^{-11} mol % is ±4%. (auth)

21708 (MLM-1178) MOUND LABORATORY PROGRESS REPORT FOR NOVEMBER, 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Nov. 30, 1963. Contract AT(33-1)-Gen-53. 24p.

As a part of the effort to establish the vapor pressure of ^{3}He as the international temperature scale between 0.3 and 3.2°K, the manometric corrections from ^{4}He to ^{3}He are being determined. The results of a single run did not agree with the predicted values. Calculations indicated that a two to one thermal diffusion column cascade is more efficient than a three to one cascade for separation of neon isotopes. Gaseous impurities in neon were reduced from 3.40 to 0.26% by passing the impure gas through a charcoal trap at liquid nitrogen temperature. About 15 liters of gas containing 9% ^{78}Kr and ^{80}Kr were accumulated. Calculations to determine the shape factors for the thermal diffusion system were completed. A six-stage cascade system was converted to an eight-stage cascade system of ten hot-wire and concentric-tube columns. Prior to the conversion the six-stage system enriched natural methane to 74%. Additionally, 74% of that enriched methane product was mass 17. The concentric-tube columns completed the purification of a commercially enriched methane from 60% to over 90% ^{13}C in the total carbon. About eight grams of the methane product were accumulated. A method was developed for fabricating threshold detectors by sealing them in copper cans. Twenty-two plutonium threshold detectors, returned because of high wipe counts, were removed from the aluminum cans; then the detectors were sealed inside copper cans by tungsten inert gas welding. The recanned threshold detectors had zero wipe counts. The erratic behavior of ^{140}Ba–^{140}La was traced to a macroscopic impurity in the stock solution. A separation of this impurity by cation exchange indicated tentatively that it is stable strontium. The multiple source method for determining coincidence correction was compared with the double source method. The multiple source method offered no advantages and had the distinct disadvantages of complexity and increased working time in comparison to the double source method. The radioactive decay of ^{208}Po and ^{209}Po is being studied. A gamma ray at 565 kev in the ^{208}Po spectrum may actually be two or more gamma rays arising from different spin states in the daughter nucleus, ^{208}Bi. This premise was confirmed by a detailed study of the electron conversion spectrum of the ^{208}Po–^{209}Po mixture. Conversion electrons apparently arise from gamma energies at 535 ± 10, 565 ± 10, and 595 ± 10 kev. The visible absorption spectrum of polonium(IV) in hydrochloric acid was measured with a mixed isotopic source of ^{208}Po and ^{209}Po. An attempt to measure the visible absorption spectrum of polonium(II) in hydrochloric acid was unsuccessful. The half life of ^{209}Po was determined in several different experiments. The most reliable data, based on a measurement of total polonium by absorption spectrophotometry and total alpha activity by gamma counting, indicated that the half life of ^{209}Po is 36 years. The currently accepted half life value is 103 years. The half life of ^{210}Po is being determined to the nearest minute at a 95% confidence level using gadolinium polonide. A study is being conducted on the separation of neodymium and samarium in preparation for the isolation of promethium. The study of a method for separating promethium from americium is nearly complete. Americium exists in promethium samples at a concentration of about three atom per cent. (auth)

21709 (MLM-1179) MOUND LABORATORY PROGRESS REPORT FOR DECEMBER 1963. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Dec. 31, 1963. Contract AT(33-1)-Gen-53. 39p.

Two polysulfide-based conductive adhesives were prepared and evaluated. One formulation, cured with an amine, increased in resistivity (from 0.30 to 50 ohm-cm) when heated at 160°F. The second, cured with lead oxide, retained its low resistivity (from 0.12 to 0.15 ohm-cm) on heating. This latter material had an adequate tensile bond strength (350 psi), but it had a lower than optimum peel strength. Zirconia fibers were evaluated as a filler for diallyl phthalate molding powders. Tensile strength, impact strength, and heat distortion temperatures were similar for zirconia and asbestos-filled plastics. The arc resistance values of the zirconia-filled formulations were lower than those of the asbestos-filled material. There appeared to be no advantage in substituting zirconia fibers for asbestos in the diallyl phthalate molding powders. A half life value of 40.2 ± 2.6 years for ^{209}Po was determined by measuring the total polonium by absorption spectrophotometry and the total alpha activity indirectly by gamma counting. A determination of the alpha decay energy of ^{212}At allowed calculation of the energy available for electron capture (Q_{EC}) of ^{208}Po. The estimate of Q_{EC} for ^{208}Po indicated that a level in ^{208}Bi at 1.43 Mev may be populated in the decay of ^{208}Po. A detailed study of the decay properties of a source of mixed ^{208}Po and ^{209}Po is in progress. Triple gamma coincidence spectrum measurements led to the tentative identification of a peak in the range of 860 to 900 kev as a crossover state in ^{208}Po. Energy assignments are difficult because of a counting rate of 0.16 count per minute per channel at the peak. The half life of ^{211}Pb was computed from 28 sets of data with two different expressions for resolving time of the proportional counter. There was good agreement between the grand means obtained by the two methods, but the individual half life values were externally inconsistent. It was found that neither expression adequately described the dead-time losses at counting rates above 10^6 counts per minute. The half life of ^{223}Ra was recomputed with counting rate limits lower than those previously applied, and the agreement between the calorimetric and alpha-counting results was improved. The ^{223}Ra half life may be useful in determining the resolving time corrections to be used in the proportional counter. Purification of the ^{140}Ba stock solution was completed, and the

interfering impurity was identified as calcium. Reversal of the usual order of adsorption of barium and lanthanum was found to occur when the adsorbed material was leached with sulfuric acid. The Weber-Schmidt Equation was used to obtain predicted thermomolecular pressure corrections on saturated vapor as a function of temperature for a number of pressure sensing tube diameters used with the helium-3 thermometer. Recent difficulties in obtaining satisfactory counting plateaus on gas-filled Geiger tubes were corrected. Attempts to obtain normal plateaus by increasing the isobutane content in the counting gas were unsuccessful. An additional resistor and capacitor used to modify the G-M input circuit of the scaler decreased the pulse to the scaling circuit to an acceptable size. The longitudinal concentration profile in a thermal diffusion column was determined using the Equation of Continuity to obtain the partial differential equation of flow in the column. Then the radial and axial portions of the partial differential equation were uncoupled. The justification for this uncoupling is that radial concentration differences are extremely small compared to the total separation in the column. The radial effect was treated as a perturbation, and the solution was arranged so that the primary terms were similar to those of the Jones and Furry theory. Succeedingly smaller correction terms may be applied to the main terms. The solution, of necessity numerical in nature, was obtained by additional numerical integrations of the terms of the operation. The preparation of gram quantities of greater than 90% purity ^{13}C is a major activity. Transport studies are being made of carbon monoxide and methane for feed evaluation. The eight-stage cascade system was converted to a nine-stage cascade system of eleven hot-wire and concentric-tube columns. The nine-stage system enriched natural methane to 97.9% mass-17 in 53.7% methane. Eight and a half grams of over 90% ^{13}C product were accumulated containing about 10% impurities. Chemical exchange and distillation are being studied for enrichment and purification of feed material for the thermal column system. Complete thermal diffusion column transport data were obtained for carbon monoxide at a wire temperature of 500°C, and column transport coefficients were computed. A method was developed to select the optimum boilup for any given ^{13}C production rate, i.e., the production rate which results in a minimum length column for the given separation. The three factors used to select the optimum conditions were: (1) actual theoretical stage requirement; (2) height equivalent to one theoretical stage; and (3) average relative volatility. Studies were made using two neon thermal diffusion columns in a two-stage cascade to separate a binary mixture of ^{20}Ne and ^{21}Ne. A determination was made of the flow rate and the length of time during which greater than 99% ^{20}Ne could be drawn off. A two-column, hot-wire, thermal diffusion cascaded unit with an infinite reservoir at the bottom processed natural krypton in the first step toward obtaining a final enrichment of over 90% ^{78}Kr and ^{80}Kr. Twenty-four liters of krypton containing about 9% ^{78}Kr and ^{80}Kr were obtained. A sample of 0.4% ^{85}Kr will be enriched for use in a calorimetric half life determination. A sample capsule was designed for the ^{85}Kr, which will be enriched by chromatography. Measurements were made to determine the effect of changes in temperature of the precision long counter (PLC) on the measured counting rates for neutron sources. For the internal standard source a counting rate decrease of 0.034% occurred with a temperature increase of 1°C. The fluctuation of the counting rate with temperature may be explained by assuming that the source moves perpendicularly to the axis of the BF_3 counter; the counting rate is proportional to the inverse square of the distance of the source from the counter; therefore, the counting rate decreases with temperature increase. Results obtained with an external source were inconclusive. One Pu–Be source was shipped and four recanned sources were returned to their users. Calorimetric determinations are currently made by comparing the bridge unbalances of a sample and a calibrating heater using a recorder; in this type of determination all but 25 to 100 microvolts are suppressed by resistance shunting one of the sample arms of the bridge. This system has three main advantages: (1) the constancy of the bridge current is less critical than in the sampling technique with a potentiometer-galvanometer system; (2) no error results from the decade box (used for the shunt resistance); and (3) any thermal emf developed in the shunt circuit is reduced by the ratio of shunt resistance to initial bridge resistance. The sensitivity for this method was plotted as function of power from the calibrating heater; the resultant straight line sloped downward slightly with increasing power. A sensitivity correction was also determined for the effect of the shunting resistance. Irradiation and counting systems used in the gamma activation analysis of beryllium were modified to incorporate four ^{3}He-filled neutron counting tubes in place of the indium foil formerly used as a detector. The ^{3}He neutron detectors were used successfully. Beryllium samples are now neutron counted during the gamma irradiation, as the ^{3}He tubes completely discriminate against the high strength gamma field of the ^{124}Sb source. The neutron tubes increased the counting efficiency by a factor of 500 compared to the indium foil previously used. Therefore, a 0.05-C source is used instead of the original 3C, making the analysis less hazardous while maintaining the high neutron count rate necessary for rapid and accurate analyses. This method has a precision of ±0.2%, and the analysis time is 45 minutes. (auth)

21710 (NAA-SR-Memo-9638) DAND—DANDURAND LEAST SQUARE ROUTINE. Gwendolynne T. Chang (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). Mar. 12, 1964. Contract AT (11-1)-Gen-8. 13p.

The Least Squares Polynomial Curve Fit Program written by A. A. Dandurand of Rocketdyne was extended to a subroutine. In this routine, the degree fit of the polynomial may be specified or a statistically best polynomial may be founded. The CRT display option of the original program is retained with the exception that the maximum number of data point is reduced to 150. (auth)

21711 (NYO-3140-1B) PHYSICAL, CHEMICAL AND BIOLOGICAL OBSERVATIONS IN THE SARGASSO SEA OFF BERMUDA, 1960–1963. Progress Report. J. H. Ryther and D. W. Menzel (Woods Hole Oceanographic Institution, Mass.). Contract AT(30-1)-3140. 76p.

A standard oceanographic station (Station S), located 15 miles SE of Bermuda in 3400 meters of water was occupied at intervals of approximately two weeks for a total of 69 times during the period Sept. 1960 to Aug. 1963 for the purpose of investigating seasonal and annual variations in the physical, chemical, and biological properties of the Sargasso Sea. The methods and equipment used are described. Temperature, salinity, inorganic and total phosphorus, nitrites, and chlorophyll are reported to the nearest hundredth of a unit. Nitrate plus nitrite, silicate, and carbon assimilation are reported to the nearest tenth. Data are tabulated. (P.C.H.)

21712 (NYO-10065) PROGRESS REPORT [ON PHYSICS AND CHEMISTRY], NOVEMBER 1, 1963. (Mas-

sachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Contracts AT(30-1)-2098 and AT(30-1)-905. 123p.

Research progress on nuclear chemistry, high-energy physics, chemistry of fission elements, cosmic radiation, nuclear structure, elementary particle theory, and nuclear theory is summarized. Work with bubble chambers and accelerators is covered individually, including developments in data gathering and reduction. (D.C.W.)

21713 (NYO-10437) CONVERGENCE OF THE QR ALGORITHM. Beresford Parlett (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Feb. 18, 1964. Contract AT(30-1)-1480. 19p.

A convergence proof is presented for the QR algorithm of J.G.F. Francis, which is used in computing matrix eigenvalues. (D.C.W.)

21714 (ORNL-3300(Vol.3)) PUBLICATIONS, REPORTS, AND PAPERS FOR 1963 FROM OAK RIDGE NATIONAL LABORATORY. K. O. Johnsson and Ann S. Klein, eds. (Oak Ridge National Lab., Tenn.). Apr. 1964. Contract W-7405-eng-26. 295p.

A bibliography is presented of technical information developed at ORNL during 1963. The references include books, journal articles, conference papers, reports, and theses, and they are arranged according to the divisions of the laboratory. Author and title keyword indexes are included. (D.L.C.)

21715 (ORNL-TM-791) SOME DEVELOPMENTS IN ENGINEERING, FABRICATION, AND FIELD SUPPORT OF LABORATORY PROGRAMS, APRIL–SEPTEMBER 1962. H. E. Seagren (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 76p.

Much of the development work in the past year has been concerned with finding solutions to design problems in alpha-gamma-neutron facilities, developing techniques for fabricating special research equipment for precise operation and measurement, and reducing the cost and manpower requirements for particular field and maintenance operations. The information is presented under the headings of engineering development, fabrication development, and field services development. Reference is made to the program or division for which the work was accomplished. The name of a contact in the Engineering and Mechanical Division for further information on a particular problem is noted. A brief index of problems is presented as a cross-reference to the Table of Contents. Comments or suggestions from readers as to other areas of information of interest to particular programs are welcomed. (auth)

21716 (ORNL-TM-794) INDEX FOR SOME DEVELOPMENTS IN ENGINEERING, FABRICATION, AND FIELD SUPPORT OF LABORATORY PROGRAMS. Reports I, II, and III, April 1962–September 1963. H. E. Seagren (Oak Ridge National Lab., Tenn.). Mar. 1964. Contract W-7405-eng-26. 11p.

The index covers items included in Report I (ORNL-TM-791, April–Sept., 1962), Report II (ORNL-TM-792, Oct. 1962–March, 1963), and Report III (ORNL-TM-793, April–Sept., 1963). The index is arranged alphabetically by subject. (B.O.G.)

21717 (SC-R-64-119) SPARK GAP DEVELOPMENT. J. K. Cole (Sandia Corp., Albuquerque, N. Mex.). Apr. 1964. Contract AT(29-1)-789. 10p. (CONF-493-1)

From 21st Supersonic Tunnel Association Meeting, Princeton, N. J., Apr. 1964.

The development of the spark-discharge, light-pulse source used in the shadowgraph and schlieren optical systems of the 12-in. trisonic and 18-in. hypersonic wind tunnels is discussed. (auth)

21718 (SC-R-64-135) QUALITY SURVEYS FROM THE VENDOR'S POINT OF VIEW. A. F. Cone, David L. Field, and Jean LaPaz (Sandia Corp., Albuquerque, N. Mex.). Apr. 1964. Contract AT(29-1)-789. 11p. (CONF-484-1; CONF-485-1)

From American Society for Quality Control 11th Western Quality Control Conference, Portland, Oreg., Apr. 1964 and American Society for Quality Control Portland Section Meeting, Portland, Oreg., Mar. 1964.

A "vendor's-eye-view" is given of the quality survey, an activity that is becoming an increasingly important safeguard of the quality and reliability of manufactured products. What attitude toward an impending survey should the vendor take? How should he prepare for it? What is he to expect from the surveying organization? When properly accomplished, a survey can be a beneficial, professional experience for all parties involved; but it should be stressed that only in a climate of adequate preparation, mutual understanding, competent investigation, objective recommendation, and constructive corrective action (when required) can maximum results be obtained. (auth)

21719 (SC-R-748) HUMAN FACTORS IN DESIGN OF RELIABLE SYSTEMS. A. D. Swain (Sandia Corp., Albuquerque, N. Mex.). Feb. 1964. Contract AT(29-1)-789. 11p. (CONF-222-2)

From 10th National Symposium on Reliability and Quality Control, Washington, D. C., Jan. 1964.

Human errors have a greater effect on system reliability than many people realize. Human errors and their rates are predictable (within an acceptable margin of error for many applications) if one takes an objective viewpoint and looks for underlying reasons for errors instead of assigning blame to those who make the errors. Propaganda campaigns to reduce human errors have a limited and often temporary effect. In most cases, it is more efficient to redesign procedures and equipment which can minimize or even eliminate certain types of human errors. Engineers can be taught valuable design principles to minimize human errors but engineers cannot take the place of a human-factors specialist. (auth)

21720 (SC-TM-264-63(15)) NONLINEAR DYNAMICS STUDY. Farrell J. Perdreauville (Sandia Lab., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 17p.

An outline is presented of a resumé of an initial investigation to correlate frequency response characteristics of nonlinear systems with their responses to transient inputs. The immediate problem considered is that of the analytical determination of frequency responses of nonlinear spring-mass models. (auth)

21721 (TID-18753) PHOTOSYNTHETIC ACTIVITY DURING THE DIVISION CYCLE IN SYNCHRONIZED EUGLENA GRACILIS. J. R. Cook (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). [May 15, 1963]. Contract AT(04-1)-Gen-12. 34p.

Axenic populations of the photosynthetic protozoan Euglena gracilis, grown with autotrophic nutrition, were synchronized with respect to cell division by culture on an alternating light-dark cycle. No cell divisions occurred in the light periods, approximately 100% of the cells dividing in the dark periods. In such cultures, the synthesis of

photosynthetic pigments and accumulation of polysaccharide were confined to the light periods. The capacity for photosynthesis, however, increased continuously over the entire light-dark cycle, and is thus not correlated with pigment content. A correlation is seen between photosynthetic capacity and protein content, suggesting that enzyme concentration of the photosynthetic apparatus might be the limiting factor. Estimates of total photosynthetic activity indicate that about 5×10^{-6} calories are required for the synthesis of a new cell. (auth)

21722 (TID-18810) CHAIN REACTIONS IN THE CHEMILUMINESCENT OXIDATION OF CERTAIN PHTHALAZINEDIONES BY POTASSIUM PEROXYDISULFATE. John R. Totter, Wayne Stevenson, and G. E. Philbrook (Georgia. Univ., Athens). [1963]. Contract AT(40-1)-2851. 24p.

A study of the relationship between maximum intensity of chemiluminescence of mixtures of phthalazinedione and peroxydisulfate ions in 0.1 M NaOH was made for 5-[N-methylamino]-2,3-dihydro-1,4-phthalazinedione. The results may be explained on a kinetic basis by the assumption that a chain reaction is initiated by a reaction between the phthalazinedione and peroxydisulfate which produces a radical from each reactant. Chains are presumably terminated by reaction of the SO_4^- radical with H_2O and subsequent decomposition of the OH formed, and by a reaction of two phthalazinedione radicals with $S_2O_8^{2-}$ with no radical end products. Similar studies with the 5-hydroxy-2,3-dihydro-1,4-phthalazinedione indicate that this compound reacts only very slowly with peroxydisulfate ion, hence a mixture of the two serves as a chemiluminescent "indicator" for radicals which are capable of initiating a similar chain reaction at rates above the spontaneous rate for SO_4^- radical formation. 5-Amino-2,3-dihydro-1,4-phthalazinedione luminescence (as well as that of other phthalazinediones) is sharply reduced by the addition of a radical scavenger which does not react at an appreciable rate with peroxydisulfate ion. (auth)

21723 (TID-18877) THE EFFECT OF WATER MOVEMENT ON ION MOVEMENT INTO THE XYLEM OF TOMATO ROOTS. William Lopushinsky (Duke Univ., Durham, N. C.). [1962]. Contract AT(40-1)-1827. 31p.

The relation between water movement and salt movement through tomato roots was studied. Water movement through detopped root systems was increased by increasing the hydrostatic pressure of the solution surrounding the roots. The rate of salt movement into the root xylem was determined by measuring the volume and salt concentration of exudate collected from the stumps. Comparisons were made of amounts of salt moved into the root xylem when water was moved under pressure, with amounts moved by active transport in the absence of external pressure. Application of pressure increased the amount of P, Ca, and total salts moved into the root xylem, but not in proportion to the increased rates of water movement. At 30 lb/in.^{2}, the amount of ions moved into the root xylem was 2.0 to 2.4 times the amount moved by active transport in the absence of pressure. The salt concentration of exudates obtained under pressure usually was less than the concentration of the external solution. Treatment of roots with sodium azide initially reduced the rates of both water and phosphorus movement to about 10% of the control rates. Longer exposure to azide resulted in an increase in the rates of both water and phosphorus movement. Possible reasons for the increased rate of salt movement under pressure are discussed. (auth)

21724 (TID-20404) RADIOISOTOPE STUDY OF INTESTINAL ABSORPTION IN HOOKWORM INFECTED PATIENTS. Final Report, September 1, 1961–August 30, 1963. Miguel Layrisse (Fundación Luís Roche. Instituto Venezolano de Investigaciones Científicas, Caracas). Contract IAEA 105/US. 33p.

Studies on the morphology of the peripheral blood and bone marrow, intestinal absorption tests, and jejunum biopsy were performed in 22 subjects harboring heavy hookworm infection. Fat absorption, measured both chemically and with oleic acid marked with ^{131}I, was normal in all patients but three, who showed slight increase of excretion; d-xylose was poorly absorbed in one out of 18 cases tested; serum vitamin B_{12} concentration was significantly diminished, and the Schilling test performed in eight patients showed 24-hr urinary excretions of B_{12} ^{58}Co over 10%. Morphological changes in the peripheral blood and bone marrow suggestive of either vitamin B_{12} or folic acid deficiency were seen in five cases. In four cases in which serum folate activity was determined values below 4.6 mμg/ml of serum were found. Jejunum biopsy, performed in 18 cases, showed only slight nonspecific changes in 14 cases. Of the other four, one showed frank atrophy of the mucosa, a second flattening of the mucosal surface and fusion of the villi, and the other two marked infiltration, especially around the crypts. The results indicate that hookworm infection per se, without the association of other factors such as malnutrition and other parasitic infections, does not as a rule lead to histological changes in the mucosa which might cause malabsorption of nutrients. (auth)

21725 (TID-20437) CELL-FREE SYNTHESIS OF WHOLE TOBACCO MOSAIC VIRUS. Final Report, March 1, 1963–February 29, 1964. George W. Cochran (Utah State Univ., Logan). Mar. 1, 1964. Contract AT (11-1)-1150. 15p.

Results of seven preliminary experiments showed that complete viral particles were synthesized by bean chloroplasts when an RNA primer was used. Virus yields were calculated from spectrophotometric measurements made on the isolated Tobacco Mosaic Virus purified first by chromatography and finally by differential centrifugation. The recovery of milligram amounts of purified whole virus is the best evidence possible for whole virus synthesis because whole virus was not present in the original normal chloroplasts and was never added during the synthesis. Further evidence is furnished for whole virus synthesis by the incorporation of labeled nucleotides into the viral RNA and the incorporation of labeled amino acid into the viral protein. It appears that some of the viral nucleotide may come from breakdown of normal chloroplast nucleoprotein. Characterization of the new virus produced by cell-free synthesis is discussed. (H.M.G.)

21726 (TID-20487) LATTICE-VIBRATION EIGENVECTORS AND APPLICATIONS THEREOF FOR NaCl AND KCl. S. S. Jaswal and D. J. Montgomery (Michigan State Univ., East Lansing). [1963]. Contract AT(11-1)-400. 38p.

Eigenvectors and eigenvalues for vibrations of the rock-salt lattice were computed in the harmonic approximation on the rigid-ion model and on a deformation-dipole model. The eigenvectors are useful in visualizing the actual motion of the ions in the normal modes, and thence for classifying the modes. The eigenvectors furthermore provide a basis for perturbation treatment. With them were computed the frequencies of the local modes, and the corre-

sponding amplitudes of impurity-atom vibrations, that result from point mass defects in NaCl and KCl. (auth)

21727 (TID-20489) NON-EQUILIBRIUM STRUCTURES IN GOLD–GERMANIUM ALLOYS. Technical Report No. 24. H. L. Luo and W. Klement, Jr. (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Mar. 1964. Contract AT(04-3)-221. 7p.

Au–Ge alloys of compositions 6 to 95 at. % Ge were rapidly quenched to room temperature and the various phases studied. A fcc phase was formed at low Ge compositions (6 to 20 at. %), and its constant lattice parameter (4.0816 ± 8 A) indicated that rapid quenching did not affect the solubility of Ge in Au. A hcp phase was formed in alloys of 10 to 30 at. % Ge, and in addition in alloys of >56 at. % Ge. The lattice parameters of the hcp phase are a = 2.844 ± 2 and c = 4.748 ± 5. Still another nonequilibrium phase of unknown structure was formed in alloys of 15 to 60 at. % Ge; its large "d" spacings indicate that its unit cell contains a large number of atoms. Quenching experiments to liquid N_2 temperatures failed to reveal amorphous phases. (D.L.C.)

21728 (UCRL-7307-T) SHOCKS UP TO INFINITE PRESSURES. R. L. Rosenberg and B. J. Alder (California. Univ., Livermore. Lawrence Radiation Lab.). Apr. 1963. Contract W-7405-eng-48. 28p.

The Thomas-Fermi-Dirac theory was used to explore the variation of the slope of the shock versus particle velocity relation with increasing shock strength. The universally constant slope found experimentally at low pressures does not continue to higher pressures. A decrease in slope is found, due to electronic excitations, which is also found in the highest pressure dynamic experiments. At still higher pressures, the slope increases again as the atoms become nearly stripped of electrons. The Thomas-Fermi-Dirac theory is shown to predict remarkably well the pressure, the compressibility, $(\partial p/\partial v)_T$, and $(\partial^2 p/\partial v^2)_T$ at low pressures, as well as the Hugoniot's for the elements with closed shell structures and the neighboring elements. (auth)

21729 (UCRL-7349) A SIMPLE LOW TEMPERATURE CHAMBER. James Waggoner and Neil Eskind (California. Univ., Livermore. Lawrence Radiation Lab.). May 6, 1963. Contract W-7405-eng-48. 4p.

A low-temperature chamber having continuous temperature control from room temperature to –185°C was constructed. The chamber consists of a portable ice chest made of polystyrene foamed beads, with additional lining of polystyrene foam. Air is circulated in the chamber by a blower, and liquid N_2 is injected into the blower outlet. Temperature control is provided by a Pt resistance thermometer and a bridge controller which controls the N_2 injection. Liquid N_2 consumption was ~4.3 l/hr at –188°C. (D.L.C.)

21730 (UCRL-10446) THE EFFECT OF Cl^- AND SO_4^{-2} ON THE PARAMAGNETIC RESONANCE LINE WIDTH OF Mn^{+2} IN AQUEOUS SOLUTION AND THE RATES OF FORMATION OF THE COMPLEX IONS. Robert G. Hayes and Rollie J. Myers (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 23, 1963. Contract W-7405-eng-48. 23p. (CONF-117-41)

From American Chemical Society 145th National Meeting, New York, Sept. 1963.

The line width of one of the hyperfine components in solutions of $Mn(ClO_4)_2$ containing added NaCl and Na_2SO_4 was studied from 20 to 200°C at 9000 Mc/sec. The chloride ion contributes little broadening at 0.1 M below 80°C but considerable broadening is obtained above this temperature. The sulfate contributes broadening at all temperatures. The rates of formation of "inner-sphere" and "outer-sphere" complexes are discussed together with their rates of relaxation. At the lower temperatures the "outer-sphere" complexes primarily contribute to the broadening while at the higher temperatures the "inner-sphere" complexes also contribute. From the broadening above 80°C the rates of formation of the "inner-sphere" complexes are evaluated. (auth)

21731 (Y-1461) DEVELOPMENT OF A PERFORMANCE SPECIMEN CHECK LIST FOR MACHINING PERSONNEL. D. J. Bostock (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Feb. 19, 1964. Contract W-7405-eng-26. 59p.

This study was the development of a modified critical incident performance evaluation form for hourly machining personnel and an investigation of factors which contribute to the variance of estimate of evaluation of performance from observation of performance. Interviews were conducted with frontline foremen to collect performance specimens which were then incorporated into a rating form along with a rating scale for overall performance. The form was tested by 22 foremen rating a sample group of 198 machinists. The ratio of effective to ineffective specimens proved to be reliable and a relevant measure of overall performance. The independent rater reliability was 0.663 while the correlation of the ratio and a rating scale value was 0.700. The regression equation of the E/I vs rating score was consistent with previous results although the slope was less due to a small range of the criterion. Weights of the importance of the performance specimens as assigned by foremen were found to be low in reliability but the average assignment correlated with Uhrbrock's scale values. A criticality factor was obtained for each specimen by predicting an Uhrbrock value from the average foremen weights. The incorporation of the criticality factors in calculating the specimen ratio did not reduce the variance of estimate in predicting evaluation from observation. By reducing the specimen list to items with high criticality factors the E/I ratio was significantly reduced. This is attributed to a reduction of redundancy and the "halo" effect operating between a portion of the effective specimens. Rater differences added significantly to the variance of estimate; however, they could not be explained by attitude or ability differences as measured by the foremen's supervision. (auth)

21732 (ANL-Trans-7) INVESTIGATIONS ON THE ULTRASTRUCTURE OF A VARIANT OF THE FURTH MICE MASTOCYTOMA. M. Sellyei and H. David. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Z. Mikroskip.-Anat. Forsch., 70: 103-17(1963). 17p.

On the basis of electronmicroscopical studies of a variant of the Furth mastocytoma growing on white mice not descended from inbreeding mast cell granula are formed in the primary substance and in the small canals of the endoplasmatic reticulum by material condensation. The shrinkage of the granula substance, the increase of the electron density and the vesicular transformation can be interpreted as secretion phenomena. These processes are increased after subcutaneous input of protamine sulfate. In the cytoplasma of the tumor cells virus-like particles are found. (auth)

21733 (ORNL-tr-19) ANALYSIS OF A CYLINDRICAL SHELL CLAMPED ALONG AN OBLIQUE CONTOUR. M. I. Estrin. Translated by Al Monks (Oak Ridge National Lab., Tenn.), from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk, Mekhan. i Mashinostr., No. 2, 151-5(Mar.-Apr. 1959). 8p.

An approximate method is presented for analyzing a cylindrical shell for which the boundary conditions along a contour are given. The contour is formed by the intersection of the shell and a plane inclined toward its axis. The stress state is divided into zero torque, pure torque, and boundary effect. (D.L.C.)

21734 (ORNL-tr-42) THEORETICAL-NUMERICAL BASIS OF THE STOCHASTIC NUMBER THEORY. M. B. Barban and A. I. Vinogradov. Translated by Al Monks (Oak Ridge National Lab., Tenn.), from Dokl. Akad. Nauk SSSR, 154: 495-6(1964). 5p.

A new estimate of the remainder term in the neutral limiting theorem for additive arithmetic functions was derived. A limiting theorem was proved by the estimate. (D.C.W.)

21735 (SC-T-64-610) STUDIES OF THE STABILITY OF NATURAL RUBBER. 1. FORMATION OF A NETWORK STRUCTURE IN NATURAL RUBBER. 2. RELATION BETWEEN NETWORK AND TENSILE STRENGTH. K. Tatebayashi and T. Endo. Translated for Sandia Corp., Albuquerque, N. Mex., from Nippon Gomu Kyokaishi, 24: 130-8(1951). 25p.

Experiments were conducted on the formation of a network in rubber due to vulcanization. Correlations were drawn between the vulcanization, bridge sulfur, modulus, and swelling. The relation between the network and tensile strength of vulcanized rubbers of different compositions was studied experimentally. The strength was found to increase with the number of meshes of the network up to a certain point, after which it decreased rapidly. The number of meshes at the point of maximum strength remained relatively constant in different rubbers, 7 to 12 $\times 10^{-5}$/g. (D.L.C.)

21736 (SC-T-64-615) THIN-LAYER ELECTROPHORESIS AND ITS APPLICATION TO THE SEPARATION OF PHENOLS AND PHENOLIC ACIDS. G. Pastuska and H. Trinks. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Chemiker Ztg., 85: 535-8(1961). 13p.

A simple electrophoresis procedure based on inorganic carrier layers is described. The advantages of this method are to be found in the high separation definition, the short period of test time required, and in the resistance of the carrier coating against aggressive reagents. The suitability of this procedure for separating mixtures of organic compounds is examined on the basis of phenols and phenolic acids. Finally, the connections between the constitution of the substances to be separated and their electrophoretic mobility are discussed. (auth)

21737 (UCRL-Trans-1040(L)) CALCULATION OF CONTINUOUS INTEGRALS BY THE MONTE CARLO METHOD. I. M. Gel'fand, A. S. Frolov, and N. N. Chentsov. Translated by S. G. Brush and M. Neuman (Univ. of California Lawrence Radiation Lab., Livermore), from Izv. Vysshikh Uchebn. Zavedenii, Mat., No. 5, 32-45(1958). 18p.

The Monte Carlo method is discussed as the natural choice for approximate calculations of continuous integrals. As an example, the lowest energy level of the polaron—an electron moving in an ionic crystal, with its associated polarization wave—is calculated following the formulation of Feynman. The method depends on writing the Green's function for the electron in terms of a Wiener integral over random trajectories, and then approximating the Wiener integral by the Monte Carlo method. The possibility of a systematic mathematical formulation of the Monte Carlo method is discussed. However, it is concluded that general considerations are usually not sufficient to determine the choice of an optimal model in a particular case, and that it is better to formulate several models for a given problem and try them out numerically in order to decide which one requires the least computing time to obtain a result of the desired accuracy. Various special tricks, such as the choice of dependent trials are discussed. It is essential to make a good choice of parameters for the random path; when this is properly done, the functional will often depend strongly on the first few parameters, and only weakly on the others. Various schemes based on the peculiarities of the functional as a function of the first few parameters can then be applied. (auth)

21738 (UCRL-Trans-1045) EVALUATION OF AEROSOL FILTERS BY THE OIL MIST METHOD. Fritz Bangert. Translated for Univ. of California Lawrence Radiation Lab., Berkeley, from Staub, 21: 298-300(1961). 12p.

The efficiency requirements for aerosol filters for breathing protection are discussed, and the advantages of the oil mist method over other methods are outlined. The principles of the oil mist method are discussed, with emphasis on the tyndallometric measurements. The effects of the oil mist concentration and other variables on the measured efficiency are considered. (D.L.C.)

21739 NUCLEAR ENERGY IN ISRAEL. A. Bar-Or (Israel Atomic Energy Commission, Tel-Aviv). Indian Eastern Engr., No. 104, 159-61(1963).

The needs of Israel for nuclear power are reviewed and some research projects are discussed. (R.E.U.)

21740 NUCLEAR ENERGY. ITS ACHIEVEMENTS AND PROSPECTS. Roger Makins (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Indian Eastern Engr., No. 104, 163-5(1963).

Nuclear energy programs in the United Kingdom are discussed. (R.E.U.)

21741 PULSE CURRENT LIMITS OF SILICON CONTROLLED RECTIFIERS. Kristian Aaland (Univ. of California, Livermore). New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1236, 17p. (UCRL-7395-T; CONF-201-3)

From Pacific Annual Meeting, Spokane, Aug. 1963.

A search for increased performance in silicon controlled rectifiers has led to the assumption that a "soaking" time is required for SCR's to become fully active. Data are presented on instantaneous resistance as a function of soaking time at various kiloampere current levels. Ultimate peak current capability is determined for some common SCR's. (L.B.S.)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

Each entry under a corporate author is a shortened version of the title of the publication, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

A

ADVANCED METALS RESEARCH CORP., SOMERVILLE, MASS.
Dispersed phases in refractory metal alloys, 18: 20512 (ASD-TDR-62-7(Pt.II))

AEROJET-GENERAL NUCLEONICS, SAN RAMON, CALIF.
Prog. rpt. on Rb/Cs evaluation, 2/16–6/30/62, 18: 19925 (AGN-8065)

AEROSPACE CORP., EL SEGUNDO, CALIF.
Program to determine plasma density from H spectral line shapes, 18: 21369 (ATN-64(9233)-8)
Shielding for nuclear electric space power plants, 18: 21676 (SSD-TDR-63-217)

AIR FORCE CAMBRIDGE RESEARCH LABS. GEOPHYSICS RESEARCH DIRECTORATE, BEDFORD, MASS.
Conference on astronomy and physics of meteors, Cambridge, 8/28–9/1/61, 18: 20710 (AFCRL-62-497)

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
EHD generator for an alternating input, 18: 20833 (GA/PHYS/63-11, 12)
Wall-stabilized, transpiration-cooled d-c electric arc, 18: 21374 (GNE/PHYS/63/2)

AKADEMIYA NAUK S.S.S.R.
Current development of emulsion method, 18: 20901 (CERN-64-6 (p.125-42))
Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)

AKTIEBOLAGET ATOMENERGI, STOCKHOLM.
Bibliography on corrosion-resistant Nb alloys, 18: 20475 (VDDIT-87)

AKTIEBOLAGET ATOMENERGI, STUDSVIK, SWEDEN.
Collective model of atomic nuclei, 18: 21189 (KR-64(Sect.VI))
Developments in collective model, 18: 21191 (KR-64(Sect.VIII))

ALLIED RESEARCH ASSOCIATES, INC., BOSTON.
Resistivity measurements, Hardhat event of Project Nougat, 18: 20200 (ARA-1054)

ALLIS-CHALMERS MFG. CO., MILWAUKEE.
Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)
Prog. rpt. on steam separation, 1–3/64, 18: 20128 (ACNP-64021)

ALLIS-CHALMERS MFG. CO. ATOMIC ENERGY DIV., WASHINGTON, D. C.
Containment of Fermi reactor plug, 18: 21641 (NP-13793)
Production of SM-1 Core III, 18: 21629 (ACNP-63638)

AMES LAB., AMES, IOWA.
Isotopic composition of V from organic sources. I., 18: 19519 (IS-655)
Magnetic properties of intra-rare earth alloys, 18: 20519 (IS-551)
Phase systems Y–Nd and Sc–Nd, 18: 20520 (IS-841)
Solvent extraction of system rare earth nitrates–HNO_3–H_2O–TBP, 18: 20098 (IS-780)
Spectrophotometric determination of perchlorate, 18: 19843 (IS-658)

ARGONNE CANCER RESEARCH HOSPITAL, CHICAGO.
Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)

ARGONNE NATIONAL LAB., ILL.
Color center phenomena in zone-refined KCN, 18: 20040 (COO-1044-15)
Prog. rpt. on reactor development, 2/64, 18: 21698 (ANL-6860)
Safety rpt. on ZPR-VI, 18: 21592 (ANL-6271)
Temperature analysis of emitters for electron heating, 18: 20183 (TID-18835)
Two-phase flow program at ANL, 18: 20170 (TID-7694(p.11-17))

ARIZONA. UNIV., TUCSON.
Prog. rpt. on coulometric analysis of rare-earth elements, 2/63–2/64, 18: 19851 (TID-20548)

ARMY MATERIALS RESEARCH AGENCY, WATERTOWN ARSENAL, MASS.
Subthermal neutron beam collimated by total reflection, 18: 21120 (AMRA-TR-63-25)

ARMY MISSILE COMMAND, REDSTONE ARSENAL, ALA.
Radiation damage by Compton scattering, 18: 20625 (N63-21469)

ASTRA, INC., RALEIGH, N. C.
Control of fast reactors, 18: 21561 (APEX-603(Del.))

ATHENS. UNIV.
Prog. rpt. on radiation effects on lipid metabolism, final, 5/15/61–3/15/64, 18: 19552 (NYO-2769-1)

ATOMIC ENERGY OF CANADA LTD., CHALK RIVER, ONT.
Effective cross sections for U-235 and Pu-239, 18: 21167 (CRRP-1191)
Fission experiments, 18: 21197 (KR-64(Sect.XVIII))
Fission resonance integrals of U-233, U-235, Pu-239, and Pu-241, 18: 21166 (CRRP-1183)
Introduction to fission physics, 18: 21186 (KR-64(Sect.II))
Theories on fission, 18: 21194 (KR-64(Sect.XV))

ATOMIC POWER DEVELOPMENT ASSOCIATES, INC., DETROIT.
Doppler coefficient for Pu-oxide-fueled fast reactors, 18: 21593 (APDA-157)

ATOMICS INTERNATIONAL. DIV. OF NORTH AMERICAN AVIATION, INC., CANOGA PARK, CALIF.
Analysis of SNAP reactor coolant cross-flow, 18: 21673 (NAA-SR-Memo-9576)
Calculating and contouring relative power and fuel element exposure for HNPF, 18: 21640 (NAA-SR-Memo-9391)
DAND—Dandurand least square routine, 18: 21710 (NAA-SR-Memo-9638)
Description of pool boiler, 18: 21554 (NAA-SR-Memo-8061)
Design of NAA-62-2, 18: 21614 (NAA-SR-Memo-8017)
Design of SRE-PEP core III variable orifice, 18: 21572 (NAA-SR-Memo-9253)
Detection of adsorbant saturation by radioisotopic analysis, 18: 21553 (NAA-SR-Memo-7771)
Distillation for recovery and characterization of high boiler, 18: 21552 (NAA-SR-Memo-7545)
Electron bombardment heater for Na, 18: 20132 (NAA-SR-Memo-8289)
Fabrication of hexagonal APM process tubes for OMR, 18: 21569

(NAA-SR-Memo-8121)
FIRED—(integer data relative read), 18: 20439 (NAA-SR-Memo-9683)
Fuel channel variable orifice design, 18: 21568 (NAA-SR-Memo-8079)
Heat capacities and compressibilities of liquids, 18: 19929 (CONF-417-20)
Hermetic sealing problems in a small BWR, 18: 21672 (NAA-SR-Memo-9507)
HNPF carburization surveillance, 18: 21637 (NAA-SR-Memo-8214)
Large Component Test Loop, 18: 21570 (NAA-SR-Memo-8217)
Large SGR fuel handling, 18: 21638 (NAA-SR-Memo-8266)
Leakage through cracks and capillaries in concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)
Materials for mechanisms operating in 1200°F Na, 18: 20472 (NAA-SR-Memo-9340)
Multi-channel, two-dimensional, two-phase flow model for SNAP-4, 18: 21557 (NAA-SR-Memo-9444)
Multigroup analysis of uniform ASCR lattices, 18: 21600 (NAA-SR-Memo-9489)
Platinum resistance thermometer circuit with 5 volts output, 18: 20283 (NAA-SR-Memo-8073)
Quick-recovery gate generator, 18: 20284 (NAA-SR-Memo-8435)
Salt velocity technique, SNAP-8, 18: 21671 (NAA-SR-Memo-9232)
SNAP shielding requirements, 18: 21670 (NAA-SR-Memo-9117)
SNAPKIN VI—program for SNAP reactor kinetics calculations, 18: 21669 (NAA-SR-9190)
SRE Core III fuel elements thermal analysis, 18: 21556 (NAA-SR-Memo-9431)
SRE-PEP nuclear analysis, 18: 20455 (NAA-SR-Memo-9406)
SRE systems and components experience for Core II, 18: 21571 (NAA-SR-Memo-9003)
Status of ASCR critical and subcritical experiments, 18: 21599 (NAA-SR-Memo-9382)
Stress analysis of SCTI mixing tees, 18: 21567 (NAA-SR-Memo-7485)
Transient behavior of two-phase forced circulation flow through channels permitting cross-flow, 18: 20165 (NAA-SR-Memo-8123)
Two permanent-magnet-rotor pumps for liquid metal, 18: 20131 (NAA-SR-Memo-2368(Rev.))
Vibration studies of large SGR fuel element, 18: 21615 (NAA-SR-Memo-9164)
1000-Mwe SGR. 90% ThO_2, 10% UO_2 alternate fuel, 18: 21616 (NAA-SR-Memo-9569)
200-Mwe SGR upper plenum coolant removal hydraulics, 18: 21639 (NAA-SR-Memo-9241)

AUSTRALIA. ATOMIC ENERGY COMMISSION RESEARCH ESTABLISHMENT, LUCAS HEIGHTS, NEW SOUTH WALES.
Irradiation of Be. II., 18: 20579 (AAEC/E-115)
Sintering studies on ceramic fuel materials, 18: 20483 (AAEC/E-116)
Two modes of pulse recording on magnetic tape, 18: 20276 (AAEC/TM-227)

AVCO CORP. AVCO-EVERETT RESEARCH LAB., EVERETT, MASS.
Prog. rpt. on self-excited MHD generator, semi-annual, 1963, 18: 20835 (NP-13814)

B

BABCOCK AND WILCOX CO., LYNCHBURG, VA.
CNSG II—conceptual merchant ship nuclear reactor design, 18: 21667 (BAW-1280)

BALLISTIC RESEARCH LABS., ABERDEEN PROVING GROUND, MD.
GRATIS—program for calculating γ transmission, 18: 21544 (BRL-Memo-1223)

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
Prog. rpt. on civilian applications, 1/64, 18: 20450 (BMI-1661(Del.))
Prog. rpt. on W-base sheet alloy, 5/8–8/8/63, 18: 20443 (AD-416199)
Properties and heat treatment of Zr–U alloys, 18: 20449 (BMI-973(Del.))
Shielding studies on salt slabs, Gd, and water, 18: 21543 (BMI-1384)

BATTELLE MEMORIAL INST. DEFENSE METALS INFORMATION CENTER, COLUMBUS, OHIO.
Properties of coated refractory metals, 18: 20452 (DMIC-195)

BOSTON UNIV.
Corrections for two-crystal whole-body counter, 18: 20337 (NYO-2553-1)

BROOKHAVEN NATIONAL LAB., UPTON, N. Y.
Beam profile indicator with solid state detectors, 18: 20327 (BNL-7880)
Bubble chamber track measurements, 18: 20328 (BNL-7932)
Cell generative cycle in normal, hyperplastic and neoplastic mammary gland, 18: 21701 (BNL-7925)
Computer-centered data handling systems, 18: 21699 (BNL-7841)
Curvature and angle measurements in bubble chamber, 18: 20329 (BNL-7933)
Data simulation with on-line computer as diagnostic and analytical tool, 18: 21158 (BNL-7836)
Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
Enigmas underlying the study of hemopoietic cell proliferation, 18: 19504 (BNL-7839)
Extracorporeal irradiation of blood lymphocyte proliferation, 18: 19548 (BNL-7926)
Field-effect transistor, 18: 20279 (BNL-7867)
Hyperfine field in Gd metal, 18: 21164 (CONF-481-36)
Incorporation of H^3-arginine in chromosomes, 18: 19518 (BNL-7007)
Manganese, melanins, and extrapyramidal system, 18: 21700 (BNL-7855)
Oxidation rates of irradiated and annealed graphites, 18: 20580 (BNL-7964)
Radiation yields in dilute inorganic solutions, 18: 20037 (BNL-6978)
Reactor physics data for enriched-U, water-moderated lattices, 18: 21594 (BNL-6975)
Responses of malignant tissue to protons, 18: 19812 (BNL-6966)
Role of salt and genetics in hypertension, 18: 21702 (BNL-7971)
Somatic mutations and carcinogenesis, 18: 19505 (BNL-7912)
Surface effects in thick Li-drifted Si radiation detectors, 18: 20326 (BNL-7853)
Temporal and spatial variation in cosmic rays, 18: 20815 (BNL-7948)
Use of cold neutrons in solid state research, 18: 21121 (BNL-7958)

BROWN UNIV., PROVIDENCE.
Beam design, 18: 20682 (TID-20563)

BRUSSELS. UNIVERSITE.
Prog. rpt. on metal oxidation, 10–12/63, 18: 20287 (EURAEC-961(Pt.2))
Vaporization of sulfides of Ca, Sr, and Ba, 18: 19939 (WADD-TR-60-782(Pt.XXI))

BUREAU OF MINES, RENO, NEV.
Direct electrolysis of UO_2 to U metal, 18: 20448 (BM-RI-6436)

BUREAU OF MINES, WASHINGTON, D. C.
Separation of rare earth metals in Zr–rare earth alloys, 18: 19839 (BM-RI-6430)

BUREAU OF YARDS AND DOCKS.
Dual-use military shelters, 18: 20197 (NAVDOCKS-P-310)

C

CALIFORNIA INST. OF TECH., PASADENA.
Non-equilibrium structures in Au–Ge alloys, 18: 21727 (TID-20489)

CALIFORNIA RESEARCH AND DEVELOPMENT CO., LIVERMORE.
Solid Bi target fabrication, 18: 20486 (MTA-15)

CALIFORNIA. UNIV., BERKELEY.
Effect of Cl^- and SO_4^{-2} on paramagnetic resonance line width of Mn^{+2}, 18: 21730 (UCRL-10446)
Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
Influence of high pressures on Mössbauer effect in Dy-161, 18: 21214 (UCRL-10630(Rev.))
Interactions of 17-Bev/c negative pions, 18: 20891 (AD-433625)
Maximal analyticity of second degree, 18: 20917 (UCRL-10786)
Reaction of ferricyanide with borohydride in aqueous solution, 18: 19938 (UCRL-11252)

CALIFORNIA. UNIV., BERKELEY. LAWRENCE RADIATION LAB.
Dislocations in recovery of cold-worked Al, 18: 20533 (UCRL-10728)
Effect of Cl^- and SO_4^{-2} on paramagnetic resonance line width of Mn^{+2}, 18: 21730 (UCRL-10446)
Evaluation of C-70045A high-speed photomultiplier, 18: 20343 (UCRL-11147)
Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
High-resolution γ spectrometry, 18: 20342 (UCRL-10781)

Influence of high pressures on Mössbauer effect in Dy-161, 18: 21214 (UCRL-10630(Rev.))
Liquid-solid transformation kinetics in Al_2O_3, 18: 20534 (UCRL-11166)
Lithium drifting apparatus for Si and Ge detectors, 18: 20344 (UCRL-11261)
Maximal analyticity of second degree, 18: 20917 (UCRL-10786)
Neutron and α counters for heavy-element column chemistry, 18: 20101 (UCRL-11300)
Reaction of ferricyanide with borohydride in aqueous solution, 18: 19938 (UCRL-11252)
Three-body final-state interactions in special case, 18: 20916 (UCRL-10773)

CALIFORNIA. UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Behavior of He gas thermometers below 77°K, 18: 20286 (UCRL-7327)
Calculation of explosion-produced craters, 18: 20123 (UCRL-7738)
Concerning quantization of flux, 18: 21097 (UCRL-7308-T)
Contained nuclear detonations in four media, 18: 20122 (UCRL-7711)
Effect of ferromagnetism upon atomic diffusion, 18: 20637 (UCRL-7290-T)
Effects of seismic waves on structures, 18: 20127 (UCRL-7773)
Heavy isotope production by nuclear devices, 18: 20126 (UCRL-7770)
High-temperature dynamic modulus measurements by ultrasonics, 18: 20196 (UCRL-7326)
Ionization equilibrium at high densities, 18: 20636 (UCRL-7286-T(Pt.2))
Low-temperature chamber, 18: 21729 (UCRL-7349)
Predicting time-of-burst of exploding wires, 18: 20634 (UCRL-7177)
Preferred orientation of polycrystalline BeO, 18: 20532 (UCRL-7381-T)
Procedure for including anisotropic scattering in neutron slowing-down calculations, 18: 21135 (UCRL-7005-T)
Production of transuranium elements in thermonuclear explosion, 18: 20638 (UCRL-7347)
Radioactivity produced by nuclear explosives, 18: 20124 (UCRL-7761)
Shock wave from underground nuclear explosion in granite, 18: 20125 (UCRL-7762)
Shocks up to infinite pressures, 18: 21728 (UCRL-7307-T)
Stability of anisotropic plasma against oscillations of the Rayleigh-Taylor type, 18: 21390 (UCRL-7330)
Tensor artificial viscosity for numerical hydrodynamics, 18: 20635 (UCRL-7205-T)
Thermal conductivity of rock salt, 18: 20530 (UCRL-6894(Rev.II))
Viscoelasticity of polymers, 18: 20531 (UCRL-7255)

CALIFORNIA. UNIV., LOS ANGELES.
Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
Photosynthetic activity during division cycle in synchronized *Euglena gracilis*, 18: 21721 (TID-18753)

CARNEGIE INST. OF TECH., PITTSBURGH.
Measurement of the rate for $\mu^- + He^3 \rightarrow H^3 + \nu$, 18: 21160 (CONF-231-5)

CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., PARR, S. C.
Prog. rpt. on CVTR operation, 3/64, 18: 21631 (CVNA-203)

CASE INST. OF TECH., CLEVELAND.
Mechanical properties of thin films, 18: 20515 (CONF-356-11)

CENTRAL UTILITIES ATOMIC POWER ASSOCIATES.
Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)

CENTRE D'ÉTUDE DE L'ENERGIE NUCLÉAIRE, BRUSSELS.
Interlamellar compounds of graphite with Br, ICl, and $FeCl_3$, 18: 19931 (EUR-542.e)
Prog. rpt. on use of Pu as reactor fuel, 7–9/63, 18: 20459 (EURAEC-954)
Prog. rpt. on use of Pu as reactor fuel, 10–12/63, 18: 20460 (EURAEC-965)

CENTRO INFORMAZIONI STUDI ESPERIENZE, MILAN.
Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)
Pressure drops in steam–water mixtures, 18: 20164 (EURAEC-1004)
Two-phase flow in progress at CISE, 18: 20182 (TID-7694(p.108-49))

CESKOSLOVENSKÁ AKADEMIE VED. ÚSTAV JADERNEHO VYZKUMU, REZ.
Ion exchangers containing P or As. I., 18: 19838 (UJV-909/63)
Isolation of long-living fission products from radioactive wastes. I., 18: 20102 (UJV-850/63)
Substoichiometric determination of traces of metals, 18: 19852 (UJV-992/63)
4-Particle wave function in SU_3 scheme, 18: 21215 (UJV-1002-63)

CHICAGO. UNIV.
Prog. rpt. on high-energy fundamental particles, 6/63, 18: 20325 (AROD-2427:1)
Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)

CITY COLL., NEW YORK.
Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)

CLEVITE CORP., CLEVELAND.
Prog. rpt. on failure mechanisms in ceramic dielectrics, final, 9/62–4/63, 18: 20526 (RADC-TDR-63-269)

COAST AND GEODETIC SURVEY, WASHINGTON, D. C.
Seismic data summary, nuclear detonation program, 1961–63, 18: 20201 (NP-13867)

COLUMBIA UNIV., NEW YORK.
Prog. rpt. on useful range of EM spectrum, 9/16–12/15/63, 18: 20627 (NP-13815)

COMPAGNIE FRANÇAISE THOMSON-HOUSTON, PARIS.
Nuclear vapotron, 18: 21617 (TID-7694(p.71-84))

COMPAGNIE PECHINEY, PARIS.
Prog. rpt. on Zr and alloys, 10–12/63, 18: 20476 (EURAEC-916)

CONNECTICUT YANKEE ATOMIC POWER CO., BOSTON.
Hazards rpt. on Connecticut Yankee Atomic Power Plant, 18: 21642 (NYO-3250-1)

CORNELL UNIV., ITHACA, N. Y.
Photoionization cross section of Ne, 18: 20728 (AD-412421)

CRUCIBLE STEEL CO. OF AMERICA, PITTSBURGH.
High-strength, elevated-temperature, corrosion-resistant steel, 18: 20446 (ASD-TDR-63-766)

D

DARTMOUTH COLL., HANOVER, N. H.
Two-phase flow and boiling studies, 18: 20176 (TID-7694(p.44-51))

DEFENSE ATOMIC SUPPORT AGENCY, WASHINGTON, D. C.
Radiological emergency procedures, 18: 20273

DEFENSE DOCUMENTATION CENTER, ARLINGTON, VA.
Bibliography on liquid metals and applications, 18: 20444 (AD-417111)

DENMARK. ATOMENERGIKOMMISSIONEN. FORSØGSINSTITUT, RISØ.
Beta decay after capture of polarized neutrons, 18: 21201 (KR-64 (Sect.XXVIII))
Beta decay of the neutron, 18: 21128 (KR-64(Sect.XXVI))
Crystal spectrometers for measurement of neutron-capture γ rays, 18: 20333 (KR-64(Sect.XX))
Multiple mirror reflection of thermal neutrons, 18: 21126 (KR-64 (Sect.XXIV))
Neutron half-life experiments, 18: 21129 (KR-64(Sect.XXVII))
Theory of β decay, 18: 21187 (KR-64(Sect.IV))

DEWEY (G. C.) AND CO., INC., NEW YORK.
Prog. rpt. on radiation effects on EM signals in air, 9/30/63, 18: 20618 (NP-13799)

DIVISION OF REACTOR DEVELOPMENT, AEC.
USAEC two-phase flow program, 18: 20169 (TID-7694(p.7-10))

DOW CHEMICAL CO. ROCKY FLATS DIV., GOLDEN, COLO.
Experiments using thermoelectric emf of a Pu–wt.% Ga alloy, 18: 20527 (RFP-351)

DU PONT DE NEMOURS (E. I.) & CO. SAVANNAH RIVER LAB., AIKEN, S. C.
Effects of pH on stress corrosion cracking of 18-8 stainless steel, 18: 20471 (CONF-492-2)
Effects of surface grinding on stress corrosion cracking of austenitic stainless steel, 18: 20470 (CONF-492-1)
Heavy water reactors for sea water distillation plants, 18: 21632 (DP-866)
Ion exchange absorption of Cs, 18: 20097 (CONF-179-1)
Isotope recovery from nuclear detonation in salt, 18: 20121 (CONF-

470-1)
Prog. rpt. on heavy water reactors, 1/64, 18: 21633 (DPST-64-83-1)
Spectra of UCl_4 in organic solutions, 18: 19935 (TID-18814)

DUKE UNIV., DURHAM, N. C.
Effect of water movement on ion movement into xylem of tomato roots, 18: 21723 (TID-18877)

DYNATECH CORP., CAMBRIDGE, MASS.
Flow-balancing device for BWR, 18: 21573 (NYO-10475)
Two-phase flow studies, 18: 20173 (TID-7694(p.35-6))

E

EINDHOVEN, NETHERLANDS. TECHNISCHE HOGESCHOOL.
Heat transfer and stability in BWR, 18: 20177 (TID-7694(p.53-60))

EUROPEAN ATOMIC ENERGY COMMUNITY.
Analysis of SAP with various oxide contents, 18: 20517 (EUR-1613.i)
Calculation of D_2O-moderated lattices, 18: 21596 (EUR-597.e)
CAPRI A.B.—IBM 7090 thermal utilization factor calculation program on ring method, 18: 21597 (EUR-1606.e)
Comparison between codes for calculation of thermal spectra in homogeneous media, 18: 21122 (EUR-1605.e)
Determination of Co content of solution, 18: 19842 (EUR-581.f)
Device for determination of purity of reactor-grade materials, 18: 20281 (EUR-523.f)
Experiments on space charge sheaths, 18: 21373 (EUR-495.i)
Extrapolated radius and height calculation for cylindrical reactor, 18: 21550 (EUR-1624.e)
Interlamellar compounds of graphite with Br, ICl, and $FeCl_3$, 18: 19931 (EUR-542.e)
Longitudinal injection of charged particles into static magnetic configuration with mirrors, 18: 21370 (CEA-R-2410)
Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
Physical properties of liquid metals, 18: 20516 (EUR-599.d)
Visualization of nucleate boiling of water, 18: 20162 (EUR-1622.f)

EUROPEAN ATOMIC ENERGY COMMUNITY. CENTRAL NUCLEAR MEASUREMENTS BUREAU, GEEL, BELGIUM.
Determination of Co content of solution, 18: 19842 (EUR-581.f)

EUROPEAN ATOMIC ENERGY COMMUNITY. EUROPEAN SCIENTIFIC DATA PROCESSING CENTER, ISPRA, ITALY.
Comparison between codes for calculation of thermal spectra in homogeneous media, 18: 21122 (EUR-1605.e)
Extrapolated radius and height calculation for cylindrical reactor, 18: 21550 (EUR-1624.e)

EUROPEAN ATOMIC ENERGY COMMUNITY. JOINT NUCLEAR RESEARCH CENTER, ISPRA, ITALY.
Analysis of SAP with various oxide contents, 18: 20517 (EUR-1613.i)
Calculation of D_2O-moderated lattices, 18: 21596 (EUR-597.e)
CAPRI A.B.—IBM 7090 thermal utilization factor calculation program on ring method, 18: 21597 (EUR-1606.e)
Comparison between codes for calculation of thermal spectra in homogeneous media, 18: 21122 (EUR-1605.e)
Determination of Co content of solution, 18: 19842 (EUR-581.f)
Determination of trace minerals in polyphenyls, 18: 19844 (ISPRA-455)
Device for determination of purity of reactor-grade materials, 18: 20281 (EUR-523.f)
Extrapolated radius and height calculation for cylindrical reactor, 18: 21550 (EUR-1624.e)
Physical properties of liquid metals, 18: 20516 (EUR-599.d)
Visualization of nucleate boiling of water, 18: 20162 (EUR-1622.f)

EUROPEAN COUNCIL FOR NUCLEAR RESEARCH, GENEVA.
Future computing needs of CERN, 18: 20438 (CERN-516 and Apps.)

EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH, GENEVA.
Classification of elementary particles, 18: 20898 (CERN-64-6(p.49-70))
Current development of emulsion method, 18: 20901 (CERN-64-6(p.125-42))
Distributed multi-channel communications system for flexible remote control and telemetry, 18: 20280 (CERN-64-21)
Easter school for emulsion physicists, St. Cergue, 3/63, 18: 20895 (CERN-64-6)
Experimental observations on resonances, 18: 20899 (CERN-64-6 (p.71-98))
High-energy scattering and Regge poles, 18: 20896 (CERN-64-6(p.1-30))
Matching of waveguide coupler for r-f separator deflecting structures, 18: 20679 (CERN-64-14)
Measuring elastic scattering at very high energy, 18: 20897 (CERN-64-6(p.31-48))
Neutrino experiments, 18: 20900 (CERN-64-6(p.99-123))

F

FANSTEEL METALLURGICAL CORP., NORTH CHICAGO, ILL.
Prog. rpt. on Nb alloy sheet rolling, 7/7/63–9/6/63, 18: 20484 (AD-418992)

FLORIDA. UNIV., GAINESVILLE.
NMR studies of adsorption on metal oxides, 18: 20632 (TID-18689)
Nuclear properties of Re, 18: 21205 (NP-13807)

FORD INSTRUMENT CO., LONG ISLAND CITY, N. Y.
Prog. rpt. on low-temp thermionic plasma study, annual, 1963, 18: 21367 (AD-429133)

FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, FONTENAY-AUX-ROSES.
Longitudinal injection of charged particles into static magnetic configuration with mirrors, 18: 21370 (CEA-R-2410)

FRANCE. COMMISSARIAT À L'ENERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, GRENOBLE.
Instabilities in boiling water loops, 18: 20178 (TID-7694(p.61-70))

FRANCE. COMMISSARIAT À L'ÉNERGIE ATOMIQUE. CENTRE D'ÉTUDES NUCLÉAIRES, SACLAY.
Application of pulsed neutron technique on reactors Alize and Aquilon, 18: 21595 (CEA-R-2376)
Atmospheric radioactivity near ground at French nuclear sites, 18: 20209 (CEA-2397)
Control panel for radiation around reactors, 18: 21562 (CEA-R-2401)
Corrosion of metallic materials by UF_6, 18: 20469 (CEA-2385)
Preparation of thin C films, 18: 20451 (CEA-2390)
Refined structure within UO_2 clusters, 18: 21612 (CEA-2387)
Separation of tracer for radiochemical analysis of Ra-226, 18: 19840 (CEA-R-2419)
Spectrometers using semi-conductor detectors, 18: 20330 (CEA-2388)

FRANCE. INSTITUT NATIONAL DES SCIENCES ET TECHNIQUES NUCLÉAIRES, PARIS.
Total neutron cross section measurements on Al, C, F and H, 18: 21159 (CEA-2399)

FRANKLIN INST., PHILADELPHIA.
Prog. rpt. on application of gas-lubricated bearings, 9–11/63, 18: 20135 (TID-20448)

FUNDACIÓN LUIS ROCHE. INSTITUTO VENEZOLANO DE INVESTIGACIONES CIENTIFICAS, CARACAS.
Prog. rpt. on radioisotope study of intestinal absorption in hookworm infected patients, 9/61–8/63, 18: 21724 (TID-20404)

G

GARRETT CORP. AIRESEARCH MFG. DIV. OF ARIZONA, PHOENIX.
Bearing tests for SPUR turbogenerator, 18: 21666 (APL-TDR-64-27)

GENERAL ATOMIC DIV., GENERAL DYNAMICS CORP., SAN DIEGO, CALIF.
GAPLSN—program for solution of one-dimensional anisotropic transport equation, 18: 21123 (GA-4972)
Prog. rpt. on thermionic converter, 7/63, 18: 20832 (GA-4511)

GENERAL DYNAMICS/FORT WORTH. DIV. OF GENERAL DYNAMICS CORP., FORT WORTH, TEX.
Prog. rpt. on effects of nuclear radiation, vacuum, and cryotemperatures on engineering materials, 6–8/63, 18: 20581 (FZK-172)

GENERAL ELECTRIC CO. ADVANCED TECHNOLOGY SERVICES, CINCINNATI.
Cross sections for reactor analysis, 18: 21551 (GEMP-283)
Gamma production cross sections, 18: 21169 (GEMP-278)
Neutron cross sections for Ta, 18: 21170 (GEMP-279)
Nine- and sixteen-group cross sections for W, 18: 21168 (GEMP-223)
Prog. rpt. on Maritime nuclear steam generator, 11/15/63–2/15/64, 18: 21668 (GEMP-274)
Prog. rpt. on reactor instrumentation and control, 1–2/64, 18: 21564

(GEMP-81)
GENERAL ELECTRIC CO. AIRCRAFT NUCLEAR PROPULSION DEPT., CINCINNATI.
Intermediate-temperature behavior of Cb–Al alloys, 18: 20474 (TID-12794)
GENERAL ELECTRIC CO. ATOMIC POWER EQUIPMENT DEPT., SAN JOSE, CALIF.
Prog. rpt. on BWR fuel cycle program, 10–12/63, 18: 21635 (GEAP-4481)
Prog. rpt. on in-core instrumentation, 9–12/63, 18: 21563 (GEAP-4483)
Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
VBWR stability test, 18: 21634 (GEAP-3971)
GENERAL ELECTRIC CO. FLIGHT PROPULSION LAB. DEPT., CINCINNATI.
Control of fast reactors, 18: 21561 (APEX-603(Del.))
GENERAL ELECTRIC CO. HANFORD ATOMIC PRODUCTS OPERATION, RICHLAND, WASH.
Costs for production of pure Hg-204, 18: 20429 (HW-71793)
Grayloc connection for Arco ATR gas loop, 18: 21681 (HW-80680)
Human response related to measured sound pressure levels from ultrasonic devices, 18: 21704 (HW-SA-3028)
Measurement of metal temperature, 18: 20282 (HW-SA-3035)
Nickel plating fuel elements, 18: 20453 (HW-72415)
Quantitative metallography of hydride phase in Zy-2 process tubes, 18: 20518 (HW-74949)
Radioactivity in northern Alaskan eskimos and their foods, 18: 20231 (HW-SA-3048)
Reactivity of mixed oxide fuel elements, 18: 21613 (HW-79960)
Shielding calculations for power reactor, 18: 21636 (HW-72844)
Two cross section libraries for MAC shielding code, 18: 21545 (HW-73381(Suppl.1))
Waste management program, 18: 21691 (HW-77163)
GENERAL ELECTRIC CO. MISSILE AND SPACE VEHICLE DEPT., BURLINGTON, VT.
Aerothermochemical behavior of graphite, 18: 20525 (R63SD89)
Longitudinal variation of MHD channel cross section for maximum power, 18: 20836 (R61SD066)
GENERAL ELECTRIC CO. SPACECRAFT DEPT., CINCINNATI.
Prog. rpt. on effect of impurities of Cs fuel upon ion engines, 12/63–2/64, 18: 20626 (NP-13800)
Prog. rpt. on K corrosion test loop experiment, 10/15/63–1/15/64, 18: 20473 (NASA-CR-54008)
GEORGIA INST. OF TECH., ATLANTA. ENGINEERING EXPERIMENT STATION.
Vapor pressure and heats of vaporization of CO and CO_2, 18: 19933 (NP-13862)
GEORGIA. UNIV., ATHENS.
Chain reactions in chemiluminescent oxidation of phthalazinediones by K peroxydisulfate, 18: 21722 (TID-18810)
GOODYEAR ATOMIC CORP., PIKETON, OHIO.
Prog. rpt. on health and safety, annual, 1963, 18: 20230 (GAT-R-335)
GT. BRIT. NATIONAL INST. FOR RESEARCH IN NUCLEAR SCIENCE. RUTHERFORD HIGH ENERGY LAB., CHILTON, BERKS, ENGLAND.
Irradiation stability of plastics and rubbers, 18: 20582 (NIRL/R/58)
Multiplate electrostatic particle separator, 18: 20680 (NIRL/R/49)
GRUMMAN AIRCRAFT ENGINEERING CORP., BETHPAGE, N. Y.
Beta radiation method of thickness measurement, 18: 20277 (ADR-09-06b-62)

H

HAVERFORD COLL., HAVERFORD, PENNA.
Studies of reactions of atomic C, 18: 20022 (CONF-322-10)

I

ILLINOIS INST. OF TECH., CHICAGO.
Bleaching of Cl_3^- molecule-ion centers in KCl–Pb, 18: 20038 (COO-1044-13)
Characterization of color centers in NaF, 18: 20039 (COO-1044-14)
Color center phenomena in zone-refined KCN, 18: 20040 (COO-1044-15)
Color centers and related phenomena in alkali halide type crystals, 18: 20622 (COO-1044-16)
Electric conductivity of K thiocyanate, 18: 19930 (COO-1044-12)
ILLINOIS INST. OF TECH., CHICAGO. IIT RESEARCH INST.
Prog. rpt. on magnetic properties of insulators, 11/16/63–2/15/64, 18: 21705 (IITRI-1184-12)
ILLINOIS. STATE WATER SURVEY, URBANA.
Radioactive rainout relations on densely gaged sampling networks, 18: 20617 (COO-1199-3)
ILLINOIS. UNIV., URBANA.
Superconductivity, 18: 21096 (NP-13809)
INSTITUT FRANÇAIS DU PÉTROLE DES CARBURANTS ET LUBRIFIANTS, PARIS.
Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
INSTITUT ZA NUKLEARNE NAUKE "BORIS KIDRIČ," BELGRADE.
Magnon scattering of slow neutrons on pyrrhotite single crystal, 18: 21131 (PAN-279)
INTERNATIONAL ATOMIC ENERGY AGENCY, VIENNA.
Conference on radiological health and safety in mining and milling nuclear materials, Vol. II, Vienna, 8/63, 18: 20267
Prog. rpt. on dosimetry in human radioepidemiology, 18: 20340 (TID-20525)
ISRAEL. ATOMIC ENERGY COMMISSION, REHOVOTH.
Absolute calibration of neutron sources, 18: 21124 (IA-800)
Inelastic scattering matrices for fast reactor calculations, 18: 21598 (IA-899)
ITALY. COMITATO NAZIONALE PER L'ENERGIA NUCLEARE, ISPRA.
Experiments on space charge sheaths, 18: 21373 (EUR-495.i)

J

JAPAN ATOMIC ENERGY RESEARCH INST., TOKYO.
Analysis of U-base alloys, 18: 19845 (JAERI-1053)
Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
JOINT INST. FOR NUCLEAR RESEARCH, DUBNA, U.S.S.R.
Anomalous singularities and amplitudes for some processes, 18: 20903 (JINR-E-1581)
Asymptotic relations between scattering amplitudes, 18: 20907 (JINR-P-1564)
Beta decay of the pion, 18: 20905 (JINR-P-1559)
Calculations of properties of rare earths, 18: 21179 (JINR-P-1573)
Decay of Dy-155, 18: 21176 (JINR-P-1479(p.35-9))
Decay of Ho-155, 18: 21175 (JINR-P-1479(p.26-34))
Decay scheme of Tm-164, 18: 21174 (JINR-P-1479(p.3-25))
Does there exist a world of very strange nuclei?, 18: 21184 (JINR-P-1583)
Energies of even-even strongly deformed nuclei, 18: 21178 (JINR-P-1568)
Excited states of non-axial odd-mass atomic nuclei, 18: 21180 (JINR-P-1574)
Hypertritium binding energy in case of nonlocal interaction, 18: 21182 (JINR-P-1579)
Inelastic scattering of polarized electrons on nuclei, 18: 21181 (JINR-P-1575)
Mean number of π^0 mesons produced in inelastic π -p collisions, 18: 20902 (JINR-E-1557)
Multiple Coulomb excitation of rotational states of even-even atomic nucleus, 18: 21177 (JINR-P-1563)
Neutron-deficient Tm-164, Ho-155, and Dy-155, 18: 21173 (JINR-P-1479)
Octupole states of even-even strongly deformed nuclei, 18: 21172 (JINR-E-1561)
Phase-shift analysis of N-N scattering, 18: 20904 (JINR-P-1553)
Positronium energy levels, 18: 20909 (JINR-P-1572)
Quasipotential equation for two-particle system, 18: 20908 (JINR-P-1566)
Resonance density in scattering on bound particles, 18: 20906 (JINR-P-1562)
Spontaneous fission of element 102 isotope with mass number 256, 18: 21183 (JINR-P-1580)
Wave propagation in structural waveguide, 18: 20623 (JINR-P-1565)

K

KNOLLS ATOMIC POWER LAB., SCHENECTADY, N. Y.
Bending-fatigue properties of Zy-4, 18: 20521 (KAPL-3016)
Theoretical calculation of (α,p) cross sections, 18: 21165 (CONF-490-1)

L

LEIDEN. RIJKSUNIVERSITEIT.
Experiments with polarized nuclei and polarized neutrons, 18: 21127 (KR-64(Sect.XXV))
Filters, shielding, and targets, 18: 21130 (KR-64(Sect.XXX))
LOS ALAMOS SCIENTIFIC LAB., N. MEX.
Behavior of metals under dynamic loading, 18: 20454 (LADC-5561)
Bibliography on chemical detectors, 18: 19847 (LAMS-2378(Vol.II))
Complex single-nucleon stripping, 18: 21204 (LADC-6302)
Determination of Mo in U–Mo alloys with α-benzoinoxime, 18: 19846 (LA-3058)
Electrorefining of Pu from Pu–Fe alloys, 18: 20099 (LA-3029)
Observation of the 1/2+ (411) orbital in Ho-165, 18: 21162 (CONF-481-3)
Prestressed concrete spherical containment vessel, 18: 20130 (LADC-5817)
Stability of step shocks, 18: 20624 (LADC-5814)
Systematics of γ decay schemes from neutron capture, 18: 21193 (KR-64(Sect.XIV))
Thermal expansion of PuC and UC–PuC solid solution, 18: 20522 (LADC-5788)
Total neutron cross sections for U-235, normal U, and Pu-239, 18: 21203 (LA-1493)
LOS ANGELES COUNTY HARBOR GENERAL HOSPITAL, TORRANCE, CALIF.
Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)

M

MARYLAND. UNIV., COLLEGE PARK.
Giant resonances in heavy nuclei, 18: 21206 (NP-13813)
Orbital angular momenta in $\Sigma^{\pm}$ mesonic decays, 18: 20914 (TID-20488)
Reactions $\pi + N \rightarrow \pi_1 + \pi_2 + N'$ from threshold to 700 Mev, 18: 20915 (TID-20490)
S-wave hyperon-nucleon interactions and SU$_3$ symmetry, 18: 20913 (TID-20483)
MASCHINENFABRIK AUGSBURG-NURNBERG A. G., NUREMBERG.
Analysis of burnout data, 18: 20179 (TID-7694(p.85-6))
Burnout measurements, 18: 20180 (TID-7694(p.87-8))
MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
Prog. rpt. on energy conversion, 9–11/63, 18: 20834 (NP-13808)
Prog. rpt. on nuclear science, 5/63–5/64, 18: 19837 (MIT-905-1)
Prog. rpt. on physics and chemistry, 11/63, 18: 21712 (NYO-10065)
Research in two-phase flow at M.I.T., 18: 20174 (TID-7694(p.37-41))
Stratospheric wind temperature and isobaric height conditions during IGY period. II., 18: 20619 (TID-20511)
Theoretical calculation of (α,p) cross sections, 18: 21165 (CONF-490-1)
Two-phase flow studies, 18: 20173 (TID-7694(p.35-6))
METALS AND CONTROLS INC., ATTLEBORO, MASS.
Prog. rpt. on coatings for Nb and Mo alloys, 1–2/64, 18: 20445 (AD-434441)
MIAMI, FLA. UNIV. MARINE LAB.
Prog. rpt. on uptake of radionuclides by microorganisms, 4/15–12/14/63, 18: 19520 (TID-20499)
MIAMI, FLA. UNIV., CORAL GABLES.
Bivariate distribution function for plasma in magnetic field, 18: 21388 (TID-20491)
Plasma Physics Bulletin, Vol. 1, 3/64, 18: 21389 (TID-20509)
MICHIGAN STATE UNIV., EAST LANSING.
Lattice-vibration eigenvectors and applications for NaCl and KCl, 18: 21726 (TID-20487)
Solid state spectroscopy: infrared absorption of decaborane, 18: 19937 (TID-20514)
MICHIGAN. UNIV., ANN ARBOR.
Current-potential relationships at rotating disc electrode, 18: 19936 (TID-20485)
Dipole-quadrupole and retardation effects in low-energy atom-atom scattering, 18: 20733 (WIS-TCI-41)
Energetic recoil atom reaction mechanisms, 18: 20041 (NMPP-167-6)
Irreversible statistical mechanics of moderately dense fluids, 18: 20633 (TID-20512)
One-speed neutron transport in adjacent half spaces, 18: 21133 (TID-20503)
Prediction and measurement of neutron chopper burst shapes, 18: 20339 (TID-20504)
Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
Thermodynamics of La and Nd hexaborides, 18: 19928 (CONF-405-6)
Three-phase a-c arc heater, 18: 20129 (ARL-64-29)
Transport solution of one-speed slab albedo problem, 18: 21134 (TID-20540)
Void fraction in cavitating Hg, 18: 20167 (NP-13812)
MIDDLE EAST TECHNICAL UNIV., ANKARA.
Maximal analyticity of second degree, 18: 20917 (UCRL-10786)
MINNESOTA. UNIV., MINNEAPOLIS.
Modulation of heavy nuclei in primary cosmic radiation, 18: 20813 (AD-434176)
MOUND LAB., MIAMISBURG, OHIO.
Prog. rpt., 10/63, 18: 21707 (MLM-1177)
Prog. rpt., 11/63, 18: 21708 (MLM-1178)
Prog. rpt., 12/63, 18: 21709 (MLM-1179)
MUNICH. TECHNISCHE HOCHSCHULE.
Crystal spectrometers for measurement of neutron-capture γ rays, 18: 20333 (KR-64(Sect.XX))

N

NAPLES. UNIVERSITÀ.
Cell generative cycle in normal, hyperplastic and neoplastic mammary gland, 18: 21701 (BNL-7925)
NATIONAL ACADEMY OF SCIENCES.
Nuclear theory reference book, 1961–62, 18: 21353
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GEORGE C. MARSHALL SPACE FLIGHT CENTER, HUNTSVILLE, ALA.
Lunar mission performance nuclear vehicles, 18: 21674 (NASA-TN-D-2157)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. GODDARD INST. FOR SPACE STUDIES, NEW YORK.
A-C conductivity of plasma, 18: 21380 (NASA-TN-X-50732)
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. LEWIS RESEARCH CENTER, CLEVELAND.
Electromagnetic wave propagation in cold, collisionless H plasma, 18: 21381 (NASA-TN-D-2071)
Existence of waves in cold, collisionless hydrogen plasma, 18: 21382 (NASA-TN-D-2273)
NATIONAL BUREAU OF STANDARDS, BOULDER, COLO.
Prog. rpt. on cryogenic magnetic refrigeration, 2/64, 18: 21095 (NBS-8239)
NATIONAL BUREAU OF STANDARDS, WASHINGTON, D. C.
Clinical dosimetry, 18: 19815 (NP-13856)
Giant resonances in heavy nuclei, 18: 21206 (NP-13813)
Radiobiological dosimetry, 18: 19549 (NP-13857)
S-wave hyperon-nucleon interactions and SU$_3$ symmetry, 18: 20913 (TID-20483)
NATIONAL RESEARCH COUNCIL.
Nuclear theory reference book, 1961–62, 18: 21353
NAVAL CIVIL ENGINEERING LAB., PORT HUENEME, CALIF.
Dose measurements for neutron in ducts, 18: 21546 (NP-13805)
NAVAL RADIOLOGICAL DEFENSE LAB., SAN FRANCISCO.
Bone growth deficit in x-irradiated rat, 18: 19555 (USNRDL-TR-721)
Ionic relationships of bioelectrogenic mechanism in isolated rat stomach, 18: 19521 (USNRDL-TR-716)
Radical yields in irradiated aromatics, 18: 20042 (USNRDL-TR-718)
Radiological recovery of land target components, 18: 20237 (USNRDL-TR-700)

Sorption of tritium and tritiated water vapor by foamed polyvinylchloride (ensolite), 18: 20458 (USNRDL-TR-717)

NEW JERSEY. STATE DEPT. OF HEALTH. RADIUM RESEARCH PROJECT, WEST ORANGE.

Data from epidemiological follow-up of New Jersey Ra cases, 18: 19550 (NYO-2181-1)

Survival experience of the radium cases, 18: 19551 (NYO-2762)

NEW YORK. STATE UNIV., BUFFALO.

Prog. rpt. on radiation and regeneration in salamanders, final, [1963], 18: 19553 (TID-20513)

NEW YORK UNIV., NEW YORK.

Asymptotic description of cusps of hydromagnetic figure of equilibrium, 18: 21387 (NYO-10435)

Finite amplitude compression waves in collision-free plasma, 18: 21386 (NYO-10434)

Moderately strong oblique shocks and simple waves in steady MHD flow, 18: 20630 (NYO-10436)

Ultra soft electronic component of environmental radiation, 18: 20341 (TID-20564)

NEW YORK UNIV., NEW YORK. ATOMIC ENERGY COMMISSION COMPUTING AND APPLIED MATHEMATICS CENTER.

Convergence of QR algorithm, 18: 21713 (NYO-10437)

NEW ZEALAND. NATIONAL RADIATION LAB., CHRISTCHURCH.

Prog. rpt. on fallout in New Zealand, 10–12/63 and annual 1963, 18: 20234 (NP-13859)

NORDISK INSTITUT FOR TEORETISK ATOMFYSIK, COPENHAGEN.

Elementary-particle theory, 18: 20910 (NP-13837)

Formulation of dynamical laws in quantum theory of fields, 18: 21023 (NP-13878)

Statistical model of nucleus, 18: 21190 (KR-64(Sect.VII))

NORTH CAROLINA STATE COLL., RALEIGH.

Convection boiling inside channels, 18: 20175 (TID-7694(p.42-3))

Prog. rpt. on population dynamics in evolution of mutant genes, final, 12/60–11/63, 18: 19506 (TID-20401)

NORTHERN STATES POWER CO., MINNEAPOLIS.

Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)

NORWAY. INSTITUTT FOR ATOMENERGI, KJELLER.

Advanced course on nuclear physics with thermal neutrons, 9/63, 18: 21185 (KR-64)

Angular correlation of capture γ rays after thermal neutron capture, 18: 21199 (KR-64(Sect.XXI))

Beam extraction, 18: 21566 (KR-64(Sect.XXIX))

Beta decay after capture of polarized neutrons, 18: 21201 (KR-64 (Sect.XXVIII))

Beta decay of the neutron, 18: 21128 (KR-64(Sect.XXVI))

Circular polarization of γ rays after capture of polarized neutrons, 18: 21200 (KR-64(Sect.XXII))

Coincidence arrangements with scintillation crystals, 18: 20331 (KR-64(Sect.X))

Collective model of atomic nuclei, 18: 21189 (KR-64(Sect.VI))

Crystal spectrometers for measurement of neutron-capture γ rays, 18: 20333 (KR-64(Sect.XX))

Decomposing γ spectra and determining spins of levels, 18: 21202 (KR-64(Sect.XXXII))

Delayed neutrons in fission, 18: 21196 (KR-64(Sect.XVII))

Developments in collective model, 18: 21191 (KR-64(Sect.VIII))

Distribution of nuclear charge in fission, 18: 21195 (KR-64(Sect.XVI))

Electron spectroscopy connected with neutron capture, 18: 20332 (KR-64(Sect.XII))

Experiments with polarized nuclei and polarized neutrons, 18: 21127 (KR-64(Sect.XXV))

Filters, shielding, and targets, 18: 21130 (KR-64(Sect.XXX))

Fission experiments, 18: 21197 (KR-64(Sect.XVIII))

Introduction to fission physics, 18: 21186 (KR-64(Sect.II)

Multiple mirror reflection of thermal neutrons, 18: 21126 (KR-64 (Sect.XXIV))

Neutron half-life experiments, 18: 21129 (KR-64(Sect.XXVII))

Possible origin of spin-orbit coupling in nuclei, 18: 21192 (KR-64 (Sect.IX))

Prog. rpt., 10–12/63, 18: 21706 (KR-66)

Prompt neutrons from slow neutron fission of U-235, 18: 21198 (KR-64 (Sect.XIX))

Semiconductor detectors, 18: 20334 (KR-64(Sect.XXXI))

Shell theory, 18: 21188 (KR-64(Sect.V))

Statistical model of nucleus, 18: 21190 (KR-64(Sect.VII))

Systematics of γ decay schemes from neutron capture, 18: 21193 (KR-64(Sect.XIV))

Theories on fission, 18: 21194 (KR-64(Sect.XV))

Theory of β decay, 18: 21187 (KR-64(Sect.IV))

Treatment of polarized thermal neutron beams, 18: 21125 (KR-64 (Sect.XXIII))

O

OAK RIDGE NATIONAL LAB., TENN.

Atomic readjustment to inner shell vacancies in Ne and Ar, 18: 20729 (CONF-481-6)

Elastic scattering of deuterons from Ni-60 and Cd-114, 18: 21161 (CONF-417-26)

Electron-slowing-down spectrum in Cu, 18: 20732

Ionization of Kr by x rays, 18: 20730 (CONF-481-7)

Mechanical properties of refractory metals, 18: 20456 (ORNL-3593)

Prog. rpt. on engineering, fabrication and field support of lab. programs, 4–9/62, 18: 21715 (ORNL-TM-791)

Prog. rpt. on engineering, fabrication and field support of lab. programs, index for 4/62–9/63, 18: 21716 (ORNL-TM-794)

Prog. rpt. on engineering, fabrication, and field support of lab. programs, 10/12–3/63, 18: 20134 (ORNL-TM-792)

Properties and cleanup of degraded TBP–Amsco solutions, 18: 20100 (ORNL-3524)

Publications, reports, and papers for 1963, 18: 21714 (ORNL-3300 (Vol.3))

Response contours of hot-pressed density of ThO_2 pellets, 18: 20524 (ORNL-3608)

Sodium separation from biological material, 18: 19841 (CONF-187-112)

Two-phase flow and boiling heat transfer at ORNL, 18: 20171 (TID-7694(p.18-23))

Weld heat-affected zone in A-212-B steel, 18: 20529 (TID-20463)

OHIO STATE UNIV., COLUMBUS.

Prog. rpt. on radiation thresholds for chorioretinal burns, 8/1/60–1/15/63, 18: 19547 (AMRL-TDR-63-71)

OHIO STATE UNIV. RESEARCH FOUNDATION, COLUMBUS.

Prog. rpt. on cathode mechanisms in metal vapor arc, final, 3/62–9/63, 18: 20631 (SC-DC-64-420)

Prog. rpt. on oxide formation in initial stages of oxidation, 7/60–6/63, 18: 20468 (AROD-2734:2)

OSLO. UNIVERSITETET.

Decomposing γ spectra and determining spins of levels, 18: 21202 (KR-64(Sect.XXXII))

Delayed neutrons in fission, 18: 21196 (KR-64(Sect.XVII))

Distribution of nuclear charge in fission, 18: 21195 (KR-64(Sect.XVI))

Possible origin of spin-orbit coupling in nuclei, 18: 21192 (KR-64 (Sect.IX))

Shell theory, 18: 21188 (KR-64(Sect.V))

P

PADUCAH GASEOUS DIFFUSION PLANT, KY.

Plasma torch production of elemental boron, 18: 19932 (KY-453)

PARIS. UNIVERSITÉ.

High-energy nuclear interactions in cosmic radiation, 18: 21209 (NP-13842)

Nuclear interactions at several tens of Bev in cosmic radiation, 18: 21207 (NP-13839)

Sensitivity of AgBr crystals in ionographic emulsions, 18: 20336 (NP-13851)

Shock waves produced by condenser discharge, 18: 20629 (NP-13850)

PARIS. UNIVERSITÉ, ORSAY.

Particle polarization in high-energy physics, 18: 20893 (AFOSR-5287)

Spins and parities of excited levels, 18: 21208 (NP-13841)

PHILLIPS PETROLEUM CO. ATOMIC ENERGY DIV., IDAHO FALLS, IDAHO.

Design of corrosion and chemical control test loop, 18: 21565 (IDO-16812)

Operation of nuclear test reactors, 18: 21682 (IDO-16871-2)
POLAND. BIURO PELNOMOCNIKA RZADU DO SPRAW WYKORZYSTANIA ENERGII JADROWEJ. CENTRALNE LABORATORIUM OCHRONY RADIOLOGICZNEJ, WARSAW.
Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
Gamma radioactivity of building materials, 18: 20210 (CLOR-20)
Radioactivity of water in Poland, 1962, 18: 20211 (CLOR-24)
POLAND. PANSTWOWA RADA DO SPRAW POKOJOWEGO WYKORZYSTANIA ENERGII JADROWEJ, WARSAW.
Kinetics of Sr-90 accumulation in body, 18: 20235 (NP-13868)
POLISH ACADEMY OF SCIENCES. INST. OF NUCLEAR PHYSICS, KRAKOW.
Magnetic interaction excited state of Gd-155 with electronic shell, 18: 21211 (PAN-299)
Reaction (d,^{3}He) on S nuclei, 18: 21210 (PAN-288)
POLISH ACADEMY OF SCIENCES. INST. OF NUCLEAR RESEARCH. WARSAW.
Annealing processes in Ge after radiation damage, 18: 20583 (PAN-473/II)
Binding energy of α particle with velocity-dependent potential, 18: 20912 (PAN-468/VII)
Improving the resolution of time-of-flight spectrometer, 18: 20338 (PAN-469/I)
Table of angular momentum weight factors $Z_{\nu}(l_1,\ldots,l_{\nu},L)$, 18: 21212 (PAN-445/VI)
PRATT AND WHITNEY AIRCRAFT DIV., UNITED AIRCRAFT CORP. CONNECTICUT AIRCRAFT NUCLEAR ENGINE LAB., MIDDLETOWN.
Thermal expansion of TiC cermets, 18: 20513 (CNLM-4234)
Thermal expansion of WC cermets, 18: 20514 (CNLM-4479)
PRINCETON UNIV., N. J.
Impurity concentrations and electron temperatures in C-stellarator, 18: 21378 (MATT-251)
Ionized plasma in He hollow cathode discharge, 18: 21375 (MATT-236)
Kinetic theory of weakly coupled gases, 18: 21376 (MATT-238)
Power balance measurements in C-Stellarator with divertor, 18: 21377 (MATT-247)
PURDUE RESEARCH FOUNDATION, LAFAYETTE, IND.
Nuclear spectroscopy and reaction kinetics, 18: 20023 (TID-20510)
PURDUE UNIV., LAFAYETTE, IND.
Annealing processes in Ge after radiation damage, 18: 20583 (PAN-473/II)
Hydromagnetic waves in current carrying plasma column, 18: 21385 (NP-13863)
Nuclear spectroscopy and reaction kinetics, 18: 20023 (TID-20510)

R

RADIO CORP. OF AMERICA. SPECIAL ELECTRONIC COMPONENTS DIV., LANCASTER, PENNA.
Prog. rpt. on thermionic energy converters, annual, 12/15/62–12/15/63, 18: 20829 (AD-429503)
RAND CORP., SANTA MONICA, CALIF.
Interdependent electrons in screening constant model of many-electron-atom, 18: 20731 (RM-3803-AEC)
RCA VICTOR CO., LTD. RESEARCH LABS., MONTREAL.
Microwave measurements of finite plasmas, 18: 21368 (AFCRL-63-161)
REACTOR CENTRUM NEDERLAND, THE HAGUE.
Angular correlation of capture γ rays after thermal neutron capture, 18: 21199 (KR-64(Sect.XXI))
Circular polarization of γ rays after capture of polarized neutrons, 18: 21200 (KR-64(Sect.XXII))
RENSSELAER POLYTECHNIC INST., TROY, N. Y.
Energy-dependent extrapolation length in polyethylene, 18: 21132 (RPI-328-4)
Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
Weld heat-affected zone in A-212-B steel, 18: 20529 (TID-20463)
RESEARCH TRIANGLE INST., DURHAM, N. C.
Radio-release technique for measurement of gas moisture, 18: 19848 (ORO-591)

S

SANDIA CORP., ALBUQUERQUE, N. MEX.
Human factors in design of reliable systems, 18: 21719 (SC-R-748)
Influence of neutron irradiation on dimensional stability of steel, 18: 20584 (SC-R-64-120)
Prog. rpt. on cathode mechanisms in metal vapor arc, final, 3/62–9/63, 18: 20631 (SC-DC-64-420)
Prog. rpt. on impact effects on spherical shells, 11/63–2/64, 18: 20195 (SC-DC-64-383)
Quality surveys from vendor's point of view, 18: 21718 (SC-R-64-135)
Spark gap development, 18: 21717 (SC-R-64-119)
SANDIA CORP. LIVERMORE LAB., LIVERMORE, CALIF.
6-Gc microwave discriminators, 18: 20285 (SCL-DR-64-13)
SANDIA LAB., ALBUQUERQUE, N. MEX.
Nonlinear dynamics study, 18: 21720 (SC-TM-264-63(15)
Use of flash heating to study combustion of liquid metal droplets, 18: 19927 (CONF-322-9)
SCHWEISSTECHNISCHE LEHR- UND VERSUCHSANSTALT, DUISBURG, GERMANY.
Prog. rpt. on electro-slag welding of reactor steel, 10–12/63, 18: 20488 (EURAEC-970)
SOCIÉTÉ ANONYME DES FORGES ET ATELIERS DU CREUSOT, LE CREUSOT, FRANCE.
Prog. rpt. on Martensite mesh parameter, 1–3/63, 18: 20537 (EURAEC-977)
SOCIÉTÉ BELGE POUR L'INDUSTRIE NUCLEAIRE, BRUSSELS.
Prog. rpt. on use of Pu as reactor fuel, 7–9/63, 18: 20459 (EURAEC-954)
Prog. rpt. on use of Pu as reactor fuel, 10–12/63, 18: 20460 (EURAEC-965)
SOCIÉTÉ NATIONALE D'ETUDE ET DE CONSTRUCTION DE MOTEURS D'AVIATION, SURESNES, FRANCE.
Adaptation of vortex flow to biphase liquid gas mixture, 18: 20181 (TID-7694(p.89-107))
SOUTHWEST RESEARCH INST., SAN ANTONIO.
Prog. rpt. on evaluation of Elk River reactor pressure vessel, 12/63–1/64, 18: 20457 (SWRI-1228-19)
Prog. rpt. on evaluation of Elk River reactor pressure vessel, 10–11/63, 18: 20528 (SWRI-1228-18)
STANFORD RESEARCH INST., MENLO PARK, CALIF.
Plant uptake of radioelements from soil, 18: 19515 (NP-13796)
Vulnerability of water facilities to contamination from nuclear attacks, 18: 20233 (NP-13806)
STANFORD UNIV., CALIF.
Convergence of random distribution function associated with branching process, 18: 20892 (AD-434059)
Three-body final-state interactions in special case, 18: 20916 (UCRL-10773)
STICHTING VOOR FUNDAMENTEEL ONDERZOEK DER MATERIE. INSTITUUT VOOR PLASMA-FYSICA, JUTPHAAS, NETHERLANDS.
Measuring time resolved electron density and ion temperature of plasmas, 18: 21384 (NP-13853)
Motion of charged particle in magnetic field, 18: 21383 (NP-13852)
STOCKHOLM. UNIV.
Experimental observations on resonances, 18: 20899 (CERN-64-6(p.71-98))
STONE AND WEBSTER ENGINEERING CORP., BOSTON.
Hazards rpt. on Connecticut Yankee Atomic Power Plant, 18: 21642 (NYO-3250-1)
STRASBOURG. UNIVERSITE.
Liquid scintillation counters, 18: 20335 (NP-13840)
SWEDEN. FÖRSVARETS FORSKNINGSANSTALT, STOCKHOLM.
Radioactivity from nuclear weapons test, 18: 20212 (NP-13846)
SWEDEN. KUNGLIGA VETENSKAPSAKADEMIEN. NOBELINSTITUTET FOR FYSIK, STOCKHOLM.
Semiconductor detectors, 18: 20334 (KR-64(Sect.XXXI))

T

TAPCO. DIV. OF THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND.
Sunflower solar Rankine system, 18: 21675 (NP-13795)

TAYLOR UNIV., UPLAND, IND.
Effect of x radiation on longevity in *Drosophila melanogaster*, 18: 19554 (TID-20550)
TEXAS. AGRICULTURAL AND MECHANICAL COLL., COLLEGE STATION. ENGINEERING EXPERIMENT STATION.
Determination of P by fast neutron activation, 18: 19850 (TID-20472)
THOMPSON RAMO WOOLDRIDGE INC., CLEVELAND.
Prog. rpt. on tungsten forging, 5/19–8/19/63, 18: 20447 (ASD-TR-7-797(IX))
Test of corrosion product separator unit in Haynes Alloy No. 25 loop containing Hg, 18: 21677 (TID-20552)
THOMPSON RAMO WOOLDRIDGE INC. TRW ELECTROMECHANICAL DIV., CLEVELAND.
Prog. rpt. on coated Nb alloys, 11/63–1/64, 18: 20523 (NP-13811)
THOMPSON RAMO WOOLDRIDGE INC. TRW SPACE TECHNOLOGY LABS., REDONDO BEACH, CALIF.
Pressure pulses in rapid transient boiling, 18: 21549 (CONF-187-111)
TOKYO UNIV.
Consequences from Pb isotopes in nature, 18: 20226 (INSJ-67)
Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
Electronic states in liquid metal, 18: 20628 (NP-13844)

U

U.S.S.R. SOVET MINISTROV. GOSUDARSTVENNYI KOMITET PO ISPOL'ZOVANIYU ATOMNOĬ ENERGII.
Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
UNION CARBIDE CORP. CARBON PRODUCTS DIV., PARMA, OHIO.
Krypton-filled thermionic converter, 18: 20831 (APL-TDR-64-28)
UNION CARBIDE NUCLEAR CO. Y-12 PLANT, OAK RIDGE, TENN.
Effect of explosive impacting on U, 18: 20535 (Y-1455)
Performance specimen check list for machining personnel, 18: 21731 (Y-1461)
UNITED AIRCRAFT CORP., EAST HARTFORD, CONN.
Prog. rpt. on collision probabilities of electrons and Cs ions in Cs vapors, 1/62–1/63, 18: 21379 (N63-13602)
UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP. CHAPELCROSS WORKS, ANNON, DUMFRIESSHIRE, SCOTLAND.
Prog. rpt. on health and safety, annual, 1963, 18: 20236 (PG-Report-565)
UNITED KINGDOM ATOMIC ENERGY AUTHORITY. PRODUCTION GROUP. CHEMICAL SERVICES DEPT., WINDSCALE, SELLAFIELD, ENGLAND.
Determination of Ca/Sr ratios in powder samples, 18: 19849 (PG-Report-583)
UNITED KINGDOM ATOMIC ENERGY AUTHORITY. REACTOR GROUP. ATOMIC ENERGY ESTABLISHMENT, WINFRITH, DORSET, ENGLAND.
Data in Winfrith nuclear data library, 7/63, 18: 21156 (AEEW-R-351)
Effect of rod spacing on burnout in simulated rod bundle, 18: 20161 (AEEW-R-178)
Errors and signal-to-noise ratio of binary cross-correlation measurements of system impulse response, 18: 20278 (AEEW-R-329)
METHUSELAH I—program for liquid-moderated reactor cells, 18: 21610 (AEEW-R-135)
Study of Canadian experiments using Winfrith five-group scheme, 18: 21591 (AEEW-M-425)
UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL, BERKS, ENGLAND.
Biological monitoring at Harwell, 1961 and 1962, 18: 20208 (AERE-R-4415)
Decreasing extraction by processing solvents of nitrosylruthenium nitrato-complexes from HNO_3 solutions. I., 18: 19924 (AERE-R-4537)
Thermodynamic properties across UC–UN solid solution range, 18: 19923 (AERE-M-1360)
UNITED KINGDOM ATOMIC ENERGY AUTHORITY. RESEARCH GROUP. CULHAM LAB., CULHAM, ABINGDON, BERKS, ENGLAND.
Kinetic theory of flute instability, 18: 21371 (CLM-R-33)
Tracing oblique rays in plasma cylinders, 18: 21372 (CLM-R-34)
UNITED STATES–EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM.
Adaptation of vortex flow to biphase liquid gas mixture, 18: 20181 (TID-7694(p.89-107))
Analysis of burnout data, 18: 20179 (TID-7694(p.85-6))
Burnout measurements, 18: 20180 (TID-7694(p.87-8))
Conference on two-phase flow problems, Brussels, 10/62, 18: 20168 (TID-7694)
Convection boiling inside channels, 18: 20175 (TID-7694(p.42-3))
Heat transfer and stability in BWR, 18: 20177 (TID-7694(p.53-60))
Instabilities in boiling water loops, 18: 20178 (TID-7694(p.61-70))
Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)
Nuclear vapotron, 18: 21617 (TID-7694(p.71-84))
Pressure drops in steam–water mixtures, 18: 20164 (EURAEC-1004)
Prog. rpt. on electro-slag welding of reactor steel, 10–12/63, 18: 20488 (EURAEC-970)
Prog. rpt. on Martensite mesh parameter, 1–3/63, 18: 20537 (EURAEC-977)
Prog. rpt. on metal oxidation, 10–12/63, 18: 20287 (EURAEC-961(Pt.2))
Prog. rpt. on steam separation, 1–3/64, 18: 20128 (ACNP-64021)
Prog. rpt. on use of Pu as reactor fuel, 7–9/63, 18: 20459 (EURAEC-954)
Prog. rpt. on use of Pu as reactor fuel, 10–12/63, 18: 20460 (EURAEC-965)
Prog. rpt. on Zr and alloys, 10–12/63, 18: 20476 (EURAEC-916)
Research in two-phase flow at M.I.T., 18: 20174 (TID-7694(p.37-41))
Two-phase flow and boiling heat transfer at ORNL, 18: 20171 (TID-7694(p.18-23))
Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
Two-phase flow and boiling studies, 18: 20176 (TID-7694(p.44-51))
Two-phase flow in progress at CISE, 18: 20182 (TID-7694(p.108-49))
Two-phase flow program at ANL, 18: 20170 (TID-7694(p.11-17))
Two-phase flow studies, 18: 20173 (TID-7694(p.35-6))
USAEC two-phase flow program, 18: 20169 (TID-7694(p.7-10))
UNIVERSIDAD MAYOR DE "SAN ANDRES," LA PAZ, BOLIVIA. LABORATORIO DE FISICA COSMICA DE CHACALTAYA.
Variations in cosmic rays and radiosonde measurements, 18: 20814 (AD-434540)
UNIVERSITY OF NOTRE DAME, NOTRE DAME, IND.
Techniques for ion-molecule reactions studies in mass spectrometer, 18: 21703 (CONF-296-4)
UPPSALA UNIV.
Coincidence arrangements with scintillation crystals, 18: 20331 (KR-64(Sect.X))
Electron spectroscopy connected with neutron capture, 18: 20332 (KR-64(Sect.XII))
UTAH STATE UNIV., LOGAN.
Prog. rpt. on cell-free synthesis of TMV, final, 3/63–2/64, 18: 21725 (TID-20437)
UTAH. UNIV., SALT LAKE CITY.
Measurement of the rate for $\mu^- + He^3 \rightarrow H^3 + \nu$, 18: 21160 (CONF-231-5)

V

VANDERBILT UNIV., NASHVILLE.
Electron-slowing-down spectrum in Cu, 18: 20732 (TID-20561)
Ultrafiltration with metal membranes, 18: 19934 (NP-13874)
VETERANS ADMINISTRATION HOSPITAL, BOSTON.
Corrections for two-crystal whole-body counter, 18: 20337 (NYO-2553-1)

W

WASHINGTON UNIV., ST. LOUIS.
Prog. rpt. on nuclear physics, final, 8/62–6/63, 18: 21157 (AFOSR-5284)
WESTINGHOUSE ELECTRIC CORP., BLAIRSVILLE, PENNA.
Refractory alloys, 18: 20485 (ASD-TDR-62-670(Pt-II))
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH.
Prog. rpt. on MHD research, 12/15/63–2/29/64, 18: 20830 (AD-432464)

WESTINGHOUSE ELECTRIC CORP. ASTRONUCLEAR LAB., PITTSBURGH.
Irradiation effects on solid lubricant materials, 18: 20585 (WANL-TNR-109)
Prog. rpt. on Nb and Ta alloy tubing, 3/62–5/63, 18: 20487 (WANL-PR-(N)-002)
WESTINGHOUSE ELECTRIC CORP. ATOMIC POWER DIV., PITTSBURGH.
Prog. rpt. on CVTR, 10–12/63, 18: 21630 (CVNA-202)
WESTINGHOUSE ELECTRIC CORP. BETTIS ATOMIC POWER LAB., PITTSBURGH.
Choosing weighting functions in method of weighted residuals, 18: 20440 (WAPD-T-1576(Rev.))
Prog. rpt. on PWR project, 10/24/63–1/23/64, 18: 21643 (WAPD-MRP-107)
WESTON GEOPHYSICAL ENGINEERS, INC., MASS.
Hazards rpt. on Connecticut Yankee Atomic Power Plant, 18: 21642 (NYO-3250-1)
WISCONSIN. UNIV., MADISON.
Dipole-quadrupole and retardation effects in low-energy atom-atom scattering, 18: 20733 (WIS-TCI-41)
Gametophyte-dependent variation in expression of R^r maize genes, 18: 19507 (TID-20402)
WOODS HOLE OCEANOGRAPHIC INSTITUTION, MASS.
Observations in Sargasso Sea off Bermuda, 1960–1963, 18: 21711 (NYO-3140-1B)
WORTHINGTON CORP. ADVANCED PRODUCTS DIV., NEWARK, N. J.
Prog. rpt. on high-pressure pump seal, 3–5/63, 18: 20133 (NYO-9802)

Y

YALE UNIV., NEW HAVEN.
Choice of primary proton energy for meson factory, 18: 21213 (TID-20440)
Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
Photoproton cross-section for O-16, 18: 21163 (CONF-481-4)
Quadrupole focusing in proton linear accelerator, 18: 20681 (TID-20457)
Studies of reactions of atomic C, 18: 20022 (CONF-322-10)
YERKES OBSERVATORY, WILLIAMS BAY, WIS.
Hydromagnetic problems bearing on geomagnetism, 18: 20621 (AFCRL-62-1075)

PERSONAL AUTHOR INDEX

Each entry after an author's name is a shortened version of the title of the report or article, followed by the *NSA* volume and abstract number. Report numbers are given in parentheses.

The phrase "Progress report" is abbreviated as "Prog. rpt.," permitting a more rapid and complete alphabetical arrangement of the titles without changing the location of the progress report titles in relation to the other titles.

Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

A

AALAND, Kristian, Pulse current limits of Si-controlled rectifiers, 18: 21741

ABARENKOV, I., New method for electronic structure of metals, 18: 20548

ABBOTT, John K., Metabolism of serum proteins in rat/mouse chimera, 18: 19590

ABE, Hiroshi, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979

ABERHAGEN, A., Continuum emission of theta pinch, 18: 21529

ABRAHAMS, K., Angular correlation of capture γ rays after thermal neutron capture, 18: 21199 (KR-64(Sect.XXI))

ABRAHAMS, K., Circular polarization of neutrons γ rays after capture of polarized, 18: 21200 (KR-64(Sect.XXII))

ABRAMOV, A. I., Physical characteristics of BR-5 reactor, 18: 21683 (ANL-Trans-9)

ABROSIMOV, N. K., Theory of channel consisting of magnetic quadrupole lenses, 18: 20703

ACHENER, P. Y., Prog. rpt. on Rb/Cs evaluation, 2/16–6/30/62, 18: 19925 (AGN-8065)

ADAIR, Robert K., Particles with a charge of $\frac{1}{3}$ e, 18: 20952

ADAMOV, I. Yu., Microwave emission in an electrodeless induction discharge, 18: 21394

ADAMS, J. B., Nuclear particle accelerators, 18: 20693

ADAMS, Leason H., Critical end point for Ce I and Ce II, 18: 20551

ADEMOLLO, M., Tests for spin and parity of the B meson, 18: 20957

ADIUTORI, Eugene F., Thermal stability in boiling systems, 18: 20187

ADORNI, N., Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)

AFONIN, O. F., Suppression of noise for observing NMR signals, 18: 19995

AFROSIMOV, V. V., Automatic stabilization of beam of fast atomic particles, 18: 20757

AGENA, H. H., Analysis of burnout data, 18: 20179 (TID-7694(p.85-6))

AGREN, Gunnar, Continuous flow analyzer for radioactivity in eluates from chromatographic columns, 18: 19870

AHMADZADEH, Akbar, Difference in pp and np total cross sections, 18: 20936

AIRAPETYANTS, M. G., Higher nervous activity of animals irradiated in the antenatal period. V., 18: 19608

AIZENBERG, N. B., Green function for scattering in region with potential barrier, 18: 21025

AJIRO, Yoshitomi, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979

AKAISHI, Jun, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)

AKISHIN, A. I., Problems of electric probes in high vacuum, 18: 20665

AKIYAMA, S., Polonium in urine of Japanese U miners, 18: 19916

AKOPOVA, V. A., Changes in spleen and lymph node of mice in response to radiation and antigenic effects, 18: 19740

AKOPOVA, V. A., Changes of glycogen content in spleen leukocytes, 18: 19741

ALBALA, M., Transplantation potential of hematopoietic tissue, 18: 19527

ALBERGOTTI, Jesse Clifton, Jr., Coulomb excitation of some radioactive nuclei, 18: 21350

ALBRIDGE, R. G., Geiger counter with post-acceleration, 18: 20361

ALDER, B. J., Shocks up to infinite pressures, 18: 21728 (UCRL-7307-T)

ALEKSANDROV, G. M., Helium-3 for filling high-pressure diffusion chamber, 18: 20390

ALEXANDER, Benjamin, Effect of lanthanides and actinides on blood coagulation. I., 18: 19535

ALEXANDER, Benjamin, Effect of lanthanides and actinides on blood coagulation. II., 18: 19536

ALEXANDER, Gideon, Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)

ALEXANDER, J. H., GAPLSN—program for solution of one-dimensional anisotropic transport equation, 18: 21123 (GA-4972)

ALEXANDER, Peter, Gamma transitions in decays of Sm-153 and Gd-153 into Eu-153, 18: 21271

ALEXANDER, S. C., Krypton-85 uptake of the human brain, 18: 19522

ALEXANIAN, R., Fasted mouse in the study of bone-marrow stem-cell kinetics, 18: 19636

ALEXANIAN, R., Stem-cell kinetics after irradiation, 18: 19635

ALFREDSON, P. G., Coated fuel particles for BeO-based fuels, 18: 20570

ALFVEN, Hannes Olof Gosta, Generation of extremely high temperature, 18: 21542

ALIA, P., Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)

ALIMARIN, I. P., Color reactions of Nb ions with certain reagents, 18: 19913

ALIMOV, A. D., Equation for π photoproduction, 18: 20921

ALKHAZOV, I. D., Spontaneous fission of Cm-244 with emission of long-range α particle, 18: 21222

ALLAN, J. T., Radiolysis of 2-propanol containing N_2O, 18: 20058

ALLARDYCE, B. W., Cross-section fluctuations in $Al^{27}(p,\alpha)Mg^{24}$ reaction, 18: 21237

ALLEN, A. O., Radiation yields in dilute inorganic solutions, 18: 20037 (BNL-6978)

ALLEN, Clifford V., Carcinoma of the urinary bladder, 18: 19827

ALLEN, J. F., Vorticity in He film, 18: 20794

ALLEN, J. S., Capture reaction $K^{39}(p,\gamma)Ca^{40}$ in giant resonance region, 18: 21363

ALMODOVAR, I., Detection attempts for α particles during irradiation with

thermal neutrons, 18: 20403
ALNIKOV, V. S., Three-rotor mechanical neutron chopper, 18: 20388
ALPEN, E. L., Effects of 50- and 250-kvp x rays on dogs, 18: 19585
ALPERIN, H. A., Itinerant electron ferromagnetism in $ZrZn_2$, 18: 20556
ALPIAR, R., METHUSELAH I—program for liquid-moderated reactor cells, 18: 21610 (AEEW-R-135)
ALTMANN, H., Neutron activation analysis in nucleic acids, 18: 19892
AMALDI, E., Future accelerator development in Western Europe, 18: 20697
AMANO, Fumio, Analytical approach for combined age-diffusion equation, 18: 21603
AMANO, Y., CdS γ-ray detector, 18: 20351
AMATO, I., Comparison between steam-sintering and H sintering of UO_2 pellets, 18: 20489
AMAYA, Kiichi, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979
AMBARTZUMYAN, S. G., Lability of separate links of visual analyzer in case of radiation lesion, 18: 19728
AMBEGAOKAR, Vinay, Electronic thermal conductivity of superconductors, 18: 21100
AMBROSINO, G., Total neutron cross section measurements on Al, C, F, and H, 18: 21159 (CEA-2399)
AMELYNCKX, S., Interlamellar compounds of graphite with Br, ICl, and $FeCl_3$, 18: 19931 (EUR-542.e)
AMENU-KPODO, Kwasi, Characterization of color centers in NaF, 18: 20039 (COO-1044-14)
AMER, N. M., Sensitive embryonic sites in Tribolium, 18: 19668
AMIEL, J. L., Treatment of acute total-body irradiation injury in man, 18: 19763
AMIEL, S., Absolute calibration of neutron sources, 18: 21124 (IA-800)
AMTEY, S. R., Decay of Cd-117, 18: 21288
ANBAR, M., Isotopic exchange between *o*-iodoanisole and inorganic I, 18: 19964
ANDELIN, Robert L'Etrenne, Self-diffusion in single-crystal W, 18: 21335
ANDERSEN, A. C., Beta irradiation of dog lymphatic structures, 18: 19601
ANDERSON, A. C., Radiation-induced hemorrhagic diathesis in dogs, 18: 19600
ANDERSON, F. A., Subcritical assembly in small university, 18: 21689
ANDERSON, Jared A., Absolute decay rate for $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, 18: 20956
ANDERSON, P. W., Superconductivity, 18: 21106
ANDERSON, Robert E., Myelofibrosis with myeloid metaplasia in survivors of Hiroshima, 18: 19568
ANDERSON, T. H., Radical yields in irradiated aromatics, 18: 20042 (USNRDL-TR-718)
ANDO, Takeshi, Synthesis of chelating agents. II., 18: 19946
ANDRADE E SILVA, J., On the irradiation of an interior target in circular accelerator, 18: 20687
ANDRESEN, A. F., Beam extraction, 18: 21566 (KR-64(Sect.XXIX))
ANDREWS, Gould A., Effects of whole-body irradiation on human marrow, 18: 19602
ANDREWS, J. Robert, Response of mammalian tumor cells to radiations, 18: 19572
ANDREWS, J. T. S., Thermodynamics of La and Nd hexaborides, 18: 19928 (CONF-405-6)
ANDROS, George, Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)
ANGEVINE, D. Murray, Late radiation effects of neoplasia, 18: 19596
ANGYAL, S. J., Specific tritium labeling by Wilzbach method, 18: 20073
ANICIN, B. A., Study of r-f discharge in a single-turn coil, 18: 21514
ANOSOVA, A. I., Effects of foreign ions on electric conductivity of irradiated alkali halide crystals, 18: 20588
ANUFRIEV, G. S., Suppression of noise for observing NMR signals, 18: 19995
ANZANI, A., Device for determination of purity of reactor-grade materials, 18: 20281 (EUR-523.f)
AOKI, F., Studies on activation analysis. I., 18: 19906
AOKI, Shigeo, Corrosion resistance of Zr–1% Mo–1% Cr and Zr–1% Mo–1% Ni alloys, 18: 20461
AONO, Osamu, High-frequency conductivity of plasmas, 18: 21401
APELGOT, Sonia, Energy dissipation of tritium in microorganisms, 18: 19633
APPLE, R. F., Titration of Cr in mixtures of fluoride salts, 18: 19869
APT, F. S., Microflora of γ-irradiated products, 18: 19558 (JPRS-24187)
ARAI, Tadashi, Heitler-London approach to many-electron problems, 18: 20747
ARAKI, Tohru, Geomagnetic variations due to high-altitude nuclear explosion, 18: 21077
ARATA, Yoshiaki, Improvements in valves, 18: 20199
ARBUZOV, M. P., Oxidation of Ni_3Al–Ni_3Nb alloy systems, 18: 20478
ARCHER, Victor E., Cancer mortality patterns among U miners and millers, U. S., 18: 20256
ARIN, M. Louis, Properties of Be compounds. V., 18: 19969
ARLOTTI, M. G., Manufacture of EGCR core I fuel assemblies, 18: 21653
ARMSTRONG, Alice H., Neutrons from interaction of 14-Mev neutrons with Li-6 and Li-7, 18: 21263
ARMSTRONG, David A., Reactive species in irradiated liquid H halides, 18: 20062
ARNDT, R. A., Isochronal differential microcalorimeter, 18: 20309
ARNOLD, K. W., Electrical breakdown between sphere and plane in vacuum, 18: 20138
ARNOLD, K. W., Emission processes at cathodes of vacuum arcs, 18: 20143
ARON, Walter, K-shell photoelectric cross sections from 200 kev to 2 Mev, 18: 20753
ARON, Walter, Polarization correlations in atomic photoeffect, 18: 20754 18: 20754
ARONOW, Saul A., Scanning with positron-emitting radioisotopes, 18: 19817
ARONSON, J., Strontium contamination in mineral analyses, 18: 19888
ARTHUR, Jett C., Jr., Radiation-induced graft polymers of cotton, 18: 20084
ARTUS, H., Production of Be-7 by photoeffect on Be, B, and C, 18: 21328
ARUTYUNYAN, R. K., Lability of separate links of visual analyzer in case of radiation lesion, 18: 19728
ASCHOFF, V., Warning equipment for Julich nuclear establishment, 18: 20257
ASCOLI-BARTOLI, U., Interferometric study of a r-f discharge, 18: 21512
ASHLEY, William H., Determination of Mo in U–Mo alloys with *α*-benzoinoxime, 18: 19846 (LA-3058)
ASINOVSKII, E. I., Properties of Ar in a stabilized arc, 18: 21498
ASKEW, J. R., Study of Canadian experiments using Winfrith five-group scheme, 18: 21591 (AEEW-M-425)
ASTROEM, B., Semiconductor detectors, 18: 20334 (KR-64(Sect.XXXI))
ATKINS, K. R., Nature of ions in liquid He, 18: 20803
ATZ, R. W., Large Component Test Loop, 18: 21570 (NAA-SR-Memo-8217)
AUCAMP, A. L., Use of ferrite memory cores, 18: 20371
AUSTIN, Robert E., Lunar mission performance nuclear vehicles, 18: 21674 (NASA-TN-D-2157)
AVERIN, V. G., Spectral line intensity variations in toroidal discharge, 18: 21435
AYER, F., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
AYPHASSORHO, M. C., X-ray emission by electron bombardment of the anode, 18: 21502
AYRE, James Lewis, Charge/discharge systems for reactors, 18: 21586
AZATYAN, R. A., Radiosensitivity of various forms of maize, 18: 19746
AZHGIREI, L. S., pp-Phase shifts at 657 Mev, 18: 20992
AZIMOV, S. A., Angular correlation of fragments and light particles in nuclear fission, 18: 21229
AZIMOV, S. A., Formation of multiple fragments at proton energy of 660 Mev, 18: 21230

B

BABAK, V. G., Asymptotic value for interaction cross section for two Fermi particles, 18: 20990
BABAYAN, V. O., Radiosensitivity of various forms of maize, 18: 19746
BACH, H. G., Febrile reactions during Ra and radiocobalt insertions, 18: 19792
BACHMAN, A., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
BACHYNSKI, M. P., Microwave measurements of finite plasmas, 18: 21368 (AFCRL-63-161)
BACIU, G., Electron injection process in betatrons, 18: 20689

BADER, Michel, Momentum accommodation above the sputtering threshold, 18: 20782
BADKAS, D. J., Negative impulse breakdown of large sphere-plane gaps, 18: 20150
BAECKSTROEM, G., Coincidence arrangements with scintillation crystals, 18: 20331 (KR-64(Sect.X))
BAECKSTROEM, G., Electron spectroscopy connected with neutron capture, 18: 20332 (KR-64(Sect.XII))
BAEV, Ilio A., Influence of anemic blood plasma on effectiveness of bone marrow transplantation, 18: 19804
BAEV, J., Nitro derivatives of monoaryl-substituted aromatic amidines, 18: 19782
BAINES, N. D., Radioactive substances act 1960, 18: 20246
BAIROIT, H., Fabrication of particulate-type fuels, 18: 20492
BAKER, B. O., Secondary emission cathode, 18: 20136
BAKER, J. B., Thermionic emission behavior of W, 18: 20875
BAKER, R. S., Two permanent-magnet-rotor pumps for liquid metal, 18: 20131 (NAA-SR-Memo-2368(Rev.))
BALABANOV, N., Natural radioactivity of organisms. I., 18: 19517
BALAZS, Nandor L., Thomas-Fermi theory of the atom, 18: 20748
BALDESCHWIELER, John D., Reducing energy variations of Van de Graaff beam, 18: 20709
BALDWIN, K., Plasma diagnostics in supersonic flow, 18: 21399
BALDWIN, L. V., Study of ion production and acceleration, 18: 20289
BALES, R. E., Uranium-mine ventilation, 18: 20269
BALTENSPERGER, W., Superconductivity in antiferromagnets, 18: 21103
BALWANZ, W., Plasma diagnostics in supersonic flow, 18: 21399
BALZARINI, M., Distribution of Bi-206 in the rat, 18: 19529
BALZHISER, Richard E., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
BALZHISER, Richard E., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
BANAIGS, J., Construction of spark chamber with transparent metal mesh, 18: 20370
BANCZYKOWNA, Krystyna, Rapid method of obtaining high-purity Ce, 18: 19996
BANG, E. M., Calculations of properties of rare earths, 18: 21179 (JINR-P-1573)
BANGERT, Fritz, Evaluation of aerosol filters, 18: 21738 (UCRL-Trans-1045)
BANKS, Charles V., Preparation, properties, and uses of WO_3, 18: 19879
BANNENBERG, J. G., Measurements on a rotating plasma, 18: 21500
BANNISTER, G., Irradiation of Be. II., 18: 20579 (AAEC/E-115)
BANNISTER, M. J., Kinetics of sintering and grain growth of BeO, 18: 20500
BANNISTER, M. J., Sinterability studies on various BeO powders, 18: 20501
BARAKINA, N. F., Method of biological dosimetry in mammals, 18: 19643
BARAN, Michael F., Wall-stabilized, transpiration-cooled d-c electric arc, 18: 21374 (GNE/PHYS/63/2)
BARANOV, B. N., Self-consistent potential for low-temperature plasma, 18: 21423
BARANOV, V. B., Boundary layer on plane in anisotropic MHD, 18: 20642
BARBAN, M. B., Theoretical-numerical basis of stochastic number theory, 18: 21734 (ORNL-tr-42)
BARBER, P. B., Impulse discharges in crossed electric and magnetic fields, 18: 21501
BARDSLEY, J., Technique for extrusion and sintering of BeO, 18: 20499
BARENDSEN, G. W., Modification of radiation damage, 18: 19760
BARGER, Vernon Duane, $K_1^0 - K_2^0$ and $\pi^+ - \pi^0$ mass differences, 18: 21007
BARHAM, J. F., 6-Gc microwave discriminators, 18: 20285 (SCL-DR-64-13)
BARIAUD, A., Annular source of ions in crossed fields, 18: 20155
BARMATZ, M., Cavitation in liquid He, 18: 20678
BARNA, A., Temperature regulator for bubble chamber, 18: 20367
BARNES, John Fayette, Momentum region in Thomas-Fermi theory, 18: 20778
BARNOTHY, Jeno M., Fib theory and influence on astronomical observation, 18: 20719
BARNOTHY, Madeleine Forro, Fib theory and influence on astronomical observation, 18: 20719
BARON, S., Nuclear applications to saline-water conversion, 18: 21665
BARONCELLI, F., Influence of nitrates on HNO, by long-chain amines, 18: 20107
BAR-OR, A., Nuclear energy in Israel, 18: 21739
BARRER, Lester A., Data from epidemiological follow-up of New Jersey Ra cases, 18: 19550 (NYO-2181-1)
BARRER, Lester A., Survival experience of the radium cases, 18: 19551 (NYO-2762)
BARRINGTON, E. P., Data in Winfrith nuclear data library, 7/63, 18: 21156 (AEEW-R-351)
BARRY, Robert E., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
BARRY, Robert E., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
BARSUKOV, V. S., Yeast cell restoration following irradiation, 18: 19678
BARTHOUX, Alain, Control panel for radiation around reactors, 18: 21562 (CEA-R-2401)
BARTLETT, E. S., Properties of coated refractory metals, 18: 20452 (DMIC-195)
BARTON, G. W., Search for natural Cm-247, 18: 20217
BARUT, A. O., Nucleon and the pion-nucleon trajectory, 18: 20948
BASINA, A. S., Decay scheme of Tm-164, 18: 21174 (JINR-P-1479 (p.3-25))
BASIULIS, A., Thermionic converter operation in multiple connection, 18: 20885
BASS, N. W., Fabrication of commercial BeO ceramics, 18: 20462
BASU, Robindra Krishna, Radiation-induced aberrant plant growth in jute, 18: 19725
BATEMAN, A. C., Prestressed concrete spherical containment vessel, 18: 20130 (LADC-5817)
BATIKYAN, I. G., Changes of blood cells and hemopoietic system due to x irradiation, 18: 19730
BATIKYAN, I. G., Changes in blood and hemopoietic system shortly after castration due to x irradiation, 18: 19731
BAUM, S. J., Effects of 50- and 250-kvp x rays on dogs, 18: 19585
BAUMEL, P., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
BAUR, H., Algebra of charge-like qualities, 18: 20981
BAXTER, A. M., Angular correlations for $C^{12}(p,p'\gamma)C^{12}$ in resonance-free region, 18: 21254
BAYMAN, B. F., Spectroscopy in the nuclear $1f_{5/2}$ shell, 18: 21275
BAYUKOV, Yu. G., Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
BAZHKOV, Yu. V., Preparation of MoS_2, 18: 20001
BEALE, J. S., Making chemicals via radiation, 18: 20048
BEARD, G. B., 4π Beta spectrometer, 18: 20360
BEARDEN, J. A., Limit of the continuous x-ray spectrum, 18: 20653
BEATTIE, J. W., Digital printout system for whole-body scanner, 18: 20346
BEAUDIN, L. J., Crystal structure of lime-stabilized zirconia, 18: 20020
BEAUDIN, L. J., Sub-solidus equilibria in CaO–ZrO_2 system, 18: 20578
BEAUDRY, B. J., Phase systems Y–Nd and Sc–Nd, 18: 20520 (IS-841)
BECK, A. E., Thermal history of the earth, 18: 21074
BECK, C. M., Radiolysis of 2-propanol containing N_2O, 18: 20058
BECK, J. S., Sensitive embryonic sites in Tribolium, 18: 19668
BECK, Marion, Sensitive embryonic sites in Tribolium, 18: 19668
BECK, Robert N., Collimators for radioisotope scanning systems, 18: 20416
BECK, Robert N., Techniques which aid in quantitative interpretation of scan data, 18: 19835
BECK, W. N., Neutron radiography of irradiated fuel, 18: 20591
BECKER, Dennis, Beta radiation method of thickness measurement, 18: 20277 (ADR-09-06b-62)
BECKJORD, Eric S., Test results on an in-pile nuclear thermionic converter, 18: 20882
BEDA, A. G., Activation cross section of Cd-108 by thermal neutrons, 18: 21220
BEDER, Douglas S., Backward-angle fermion-boson scattering, 18: 20942
BEDER, Earl, Momentum exchange in elastic scattering, 18: 21342
BEENAKKER, J. J. M., Dilute mixtures of He-3 in superfluid He-4, 18: 20801
BEER, O., Study of cathode sputtering of metal crystals, 18: 20785
BEERBOWER, Alan, Method of using radioactive tracers, 18: 20427
BEGHI, G., Analysis of SAP with various oxide contents, 18: 20517 (EUR-1613.i)
BEHAR, M., Krypton-85 uptake of the human brain, 18: 19522

BELL, Alan, Improved nuclear power reactor, 18: 21662
BELLEMANS, A., Free energy of plasma at infinite dilution, 18: 21400
BELLENI-MORANTE, A., Heat transfer in hollow cylindrical cell, 18: 20184
BELLER, L. S., Quick-recovery gate generator, 18: 20284 (NAA-SR-Memo-8435)
BELOV, L. M., Spontaneous fission of Cm-244 with emission of long-range α particle, 18: 21222
BELOVA, O. M., Strontium-90 content of food products after cooking, 18: 20238 (JRPS-24139)
BEL'SKII, S. A., Ordered particle motion in α installation, 18: 21436
BENADIK, Anton, Making use of binary mixtures, 18: 20069
BENCZER-KOLLER, N., Internal conversion in Sn-119, 18: 21365
BENDER, D., Structure and electronic properties of Nb–Ru alloys, 18: 20557
BENDER, Iring, Low-energy πK scattering, 18: 20977
BENDER, M. A., Cell-killing by incorporated ^{3}H-thymidine and ^{3}H-uridine, 18: 19645
BENDER, M. A., HeLa S-3 cells after incorporation of ^{3}H-thymidine or ^{3}H-uridine, 18: 19644
BENDER, Michael A., Chromosone aberrations in irradiated human subjects, 18: 19582
BENISTON, M. J., Production of hyperfragments, 18: 20938
BENJAMIN, P. W., Measurement of proton ranges in Ilford K-1 emulsion, 18: 20372
BEN-MENAHEM, Ari, Excitation of seismic surface waves by nuclear explosions, 18: 21081
BENSTED, J. P. M., Immune responses of continuously irradiated mice, 18: 19623
BENTON, Arnold, Thermodynamic properties of Pu-239 as ideal gas, 18: 19956
BEN'YAMINOVICH, M. B., Energy distribution of Ni atoms formed in cathode sputtering, 18: 20666
BERENYI, Denes, Conditions of positive β decay, 18: 21227
BERGER, Harold, Neutron radiography of irradiated fuel, 18: 20591
BERGMANN, Helmut, Effects of uv- or x irradiation of skin on erythropoiesis, 18: 19712
BERGNER, Per-Erik E., Tracer dynamics in metabolic systems, 18: 19537
BERGONZOLI, F., SRE Core III fuel elements thermal analysis, 18: 21556 (NAA-SR-Memo-9431)
BERGONZOLI, F., 200-Mwe SGR upper plenum coolant removal hydraulics, 18: 21639 (NAA-SR-Memo-9241)
BERKHAN, Ernst, Light-yield characteristics of anthracene and *p*-terphenyl crystals, 18: 20409
BERLAND, R. F., Multi-channel, two-dimensional, two-phase flow model for SNAP-4, 18: 21557 (NAA-SR-Memo-9444)
BERLIN, L. B., Cortisone therapy applied to healthy and irradiated rabbits, 18: 19613
BERLINCOURT, Don A., Prog. rpt. on failure mechanisms in ceramic dielectrics, final, 9/62–4/63, 18: 20526 (RADC-TDR-63-269)
BERNARD, Harold, Management of radioactive wastes, 18: 21694
BERNARDINI, G., High-energy neutrino physics at CERN, 18: 20967
BERNAT, Miguel, Radioisotopes as sources of energy, 18: 20428
BERNICK, R. L., SNAP shielding requirements, 18: 21670 (NAA-SR-Memo-9117)
BERNKOPF, H., Effect of uv-irradiated inactive vaccinia virus on development of Shay leukemia in rats, 18: 19614
BERNSTEIN, Richard B., Dipole-quadrupole and retardation effects in low-energy atom-atom scattering, 18: 20733 (WIS-TCI-41)
BERRY, E. R., Shielding for nuclear electric space power plants, 18: 21676 (SSD-TDR-63-217)
BERRY, Roger J., Response of mammalian tumor cells to radiations, 18: 19572
BERTOCCHI, L., Vertex renormalization in potential theory, 18: 21038
BERTOLINI, E., Breakdown in a theta-pinch apparatus, 18: 21525
BERTULIS, V. A., Accelerated particle phase oscillations by harmonic linearization, 18: 20701
BERTULIS, V. A., External action on accelerated particle phase oscillations, 18: 20700
BESWICK, Clifford Kenneth, Radioactive selector circuit, 18: 20324
BETTINALI, Carlo, Calcium and Zr phosphate, 18: 19944
BEUCHOT, G., Improvement of performance of wave generator, 18: 20303
BEUSCHER, H., Study of cathode sputtering of metal crystals, 18: 20785
BEYER, Frank R., Fuel channel variable orifice design, 18: 21568 (NAA-SR-Memo-8079)
BHADURI, R. K., Velocity-dependent N-N potentials and saturation in nuclear matter, 18: 21223
BHARTENDU, Atmospheric waves from U.S.S.R. explosions, 18: 21072
BHATTACHARJEE, S. B., Influence of β radiation on hemic elements in chronic leukemias, 18: 19789
BICHEIKINA, N. I., Free O in brain and bone marrow during chemical protection against radiation, 18: 19801
BIELEN, H., Detection attempts for α particles during irradiation with thermal neutrons, 18: 20403
BIGGERS, J. D., Effect of x rays on embryonic chick tibiotarsus, 18: 19657
BIGGERSTAFF, G. E., Plasma torch production of elemental boron, 18: 19932 (KY-453)
BIGHAM, C. B., Fission resonance integrals of U-233, U-235, Pu-239, and Pu-241, 18: 21166 (CRRP-1183)
BIKTIMIROV, S. Kh., Polarization investigation in proton scattering at high energy, 18: 20383
BILDSTEIN, H., Electrodeposition of Th and U, 18: 20494
BILDSTEIN, H., Electrodeposition of rare-earth elements, 18: 20495
BILLARD, F., Determination of filter efficiency using radioactive ions, 18: 20239 (NP-tr-1124)
BILLEN, D., Inhibition of DNA synthesis in murine bone-marrow cells, 18: 19524
BINFORD, Thomas O., Absolute decay rate for $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, 18: 20956
BINGHAM, F. W., Capture reaction $K^{39}(p,\gamma)Ca^{40}$ in giant resonance region, 18: 21363
BINGHAM, F. W., Scattering of 5 to 15-Mev protons from Be-9, 18: 21362
BIRGER, N. G., Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
BIRK, Meir, Evaluation of C-70045A high-speed photomultiplier, 18: 20343 (UCRL-11147)
BIRKS, J. B., Scintillation spectra of organic solutions, 18: 20046
BISHOP, A. S., Impurity concentrations and electron temperatures in C-stellarator, 18: 21378 (MATT-251)
BISHOP, A. S., Power balance measurements in C-Stellarator with divertor, 18: 21377 (MATT-247)
BISI, V., Study of the $K_{\mu 3}$ decay spectrum, 18: 20961
BISWAS, N. N., π^-p Interactions at 10 Bev/c, 18: 20951
BISWAS, S. N., Pion-nucleon S-wave scattering lengths by N/D method, 18: 20937
BLACKWELL, H. Richard, Prog. rpt. on radiation thresholds for chorioretinal burns, 8/1/60–1/15/63, 18: 19547 (AMRL-TDR-63-71)
BLACKWELL, Percy L., Impact of nuclear technology on highway engineering, 18: 20120
BLAGOVESHCHENSKII, V. M., Source of high-intensity protons, 18: 20690
BLAIR, Allen G., Complex single-nucleon stripping, 18: 21204 (LADC-6302)
BLAIR, D. T. A., Static breakdown voltage of uniform-field spark gaps, 18: 20602
BLAIR, J. M., Differential cross sections for reaction $Li^7(Li^7,\alpha)Be^{10}$, 18: 21283
BLAIR, J. M., Differential cross sections for $C^{13}(Li^6,\alpha)N^{15}$, 18: 21295
BLAKE, C. A., Jr., Properties and cleanup of degraded TBP–Amsco solutions, 18: 20100 (ORNL-3524)
BLANN, Marshall, Reactions induced in Ni-58 with He ions, 18: 21294
BLAZEWSKA, Z., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
BLINKIN, A. M., Diffusion of Fe in Zr, 18: 20561
BLINOV, M. V., Spectrometer for fission neutrons, 18: 20384
BLOCK, F. G., In-pile testing of a nuclear-fueled thermionic energy converter, 18: 20881
BLOEMBERGEN, Nicolaas, Conference on quantum electronics, Paris, 2/63. I and II., 18: 20316
BLOOM, S. D., Circular polarization of γ rays following β decay of Al-24 and Na-24, 18: 21269
BLOOMFIELD, C. H., Study of ion-atom interchange, 18: 20021
BLOSS, W., Experiments on the low-voltage arc, 18: 20851
BLUM, Pierre, Preparation of UC powder, 18: 20467
BOARDMAN, Charles R., Contained nuclear detonations in four media,

18: 20122 (UCRL-7711)
BOCHAGOV, B. A., Pulse ionization chamber for measuring angular energy distributions of fission fragments, 18: 20392
BOCQUET, M., Heat conduction by nuclear graphite, 18: 20539
BODENHEIMER, W., Analysis of $Eu(C_2O_4)_3$ and Eu(II) salts, 18: 19897
BODENSTEDT, E., Investigation of hfs interaction in $Hf(NH_4)_3F_8$ crystals, 18: 21321
BODINE, J. E., Oxidative decladding of UO_2 fuels, 18: 20111
BOEHM, F., Mossbauer effect in Tm-169, 18: 21290
BOERSCH, H., Scattering of Li^+ ions on rare gases, 18: 21318
BOES, David J., Reactions of Be in oxidizing environments, 18: 19985
BOETTGER, O., Decay rates of H^- ions in isochronous cyclotron, 18: 20698
BOGAARDT, M., Heat transfer and stability in BWR, 18: 20177 (TID-7694(p.53-60))
BOGDANOV, A. V., Magnetosonic waves in nonisothermal plasma, 18: 21431
BOGEN, P., Electron temperature and density in a θ-pinch discharge, 18: 21526
BOGOMOLOV, A. V., Bubble chamber in magnetic field, 18: 20389
BOHAN, William A., Transient radiation effects in components and circuits, 18: 10321
BOLAN, P., Emitter work function in arc-mode thermionic converters, 18: 20867
BOLEN, L. N., Neutron photoproduction cross sections of La and Pr, 18: 21278
BOLTZ, D. F., Light absorption spectrometry, 18: 19860
BOND, Victor P., Effects of whole-body irradiation on human marrow, 18: 19602
BOND, Victor P., Responses of malignant tissue to protons, 18: 19812 (BNL-6966)
BONDELID, R. O., (p,n) Threshold-curve shapes and measurements of threshold energy with H_1^+ beams, 18: 21284
BONDORF, J. P., Statistical model of nucleus, 18: 21190 (KR-64 (Sect.VII))
BONNET, C., Visualization of nucleate boiling of water, 18: 20162 (EUR-1622.f)
BONTE, Frederick J., Effects of x irradiation on fine structure of HeLa cells, 18: 19723
BOONE, E. M., Prog. rpt. on cathode mechanisms in metal vapor arc, final, 3/62–9/63, 18: 20631 (SC-DC-64-420)
BOONE, Max L. M., Radiation casualties—newer aspects of mass casualty care, 18: 20258
BOOS, E. G., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
BORCHERTS, Robert H., VO^{2+} and x-ray produced V^{2+} in Tutton salt, 18: 20059
BORG, R. J., Effect of ferromagnetism upon atomic diffusion, 18: 20637 (UCRL-7290-T)
BORISOV, V. S., Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
BORISOVA, N. B., Effects of γ radiation on autotrophic mutants of *coliform bacterium*, 18: 19688
BORKOWSKA, Aleksandra, Rapid method of obtaining high-purity Ce, 18: 19996
BORKOWSKI, Boguslaw, Rapid method of obtaining high-purity Ce, 18: 19996
BORNEMIER, D. D., Nuclear energy states of In-115, 18: 21289
BOROVIK-ROMANOVA, T. F., (BOROVIK, T.) (ROMENEVA, T.), Determination of Li, Rb, and Cs, 18: 19853 (CEA-tr-R-1711)
BORREANI, G., Study of the $K_{\mu 3}$ decay spectrum, 18: 20961
BORYSOWICZ, J., Binding energy of α particle with velocity-dependent potential, 18: 20912 (PAN-468/VII)
BOSE, S. K., Pion-nucleon S-wave scattering lengths by N/D method, 18: 20937
BOST, D. S., SRE-PEP nuclear analysis, 18: 20455 (NAA-SR-Memo-9406)
BOSTOCK, D. J., Performance specimen check list for machining personnel, 18: 21731 (Y-1461)
BOTTIGLIONI, F., Fluctuations and rotations in a plasma column, 18: 21504
BOTTOMLEY, R. C., Pulsed neutron source for reactor measurements, 18: 21605
BOUDNITSKAYA, E. G., Effects of x rays on RNA of HeLa cells, 18: 19599
BOWEN, D. H., Growth of neutron-irradiated MgO, 18: 20597
BOWEN, S., Three-phase a-c arc heater, 18: 20129 (ARL-64-29)
BOYD, J., ω–ρ interference, 18: 21017
BOYER, A., Improvement of performance of wave generator, 18: 20303
BOYER, Hilda F., Poststorage viability of human bone marrow, 18: 19526
BOYLETT, F. D. A., Chemical effects of d-c discharges, 18: 20013
BOZEK, E., Magnetic interaction excited state of Gd-155 with electronic shell, 18: 21211 (PAN-299)
BRAAMS, C. M., Edge effect in charged-particle analyzing magnets, 18: 20644
BRAAMS, Reinier, Effect of electron radiation on tensile strength of tendon. II., 18: 19629
BRADLEY, R., Strength of irradiated MgO, 18: 20595
BRADT, G., Digital printout system for whole-body scanner, 18: 20346
BRAGA, C. Lloyd, Scintillation spectra of organic solutions, 18: 20046
BRAGIN, A. A., Telemetry of radioactive emissions, 18: 20225
BRAHMAVAR, S. M., Excited states of even-even nuclei, 18: 21303
BRAMBEL, Charles E., Hemopoietic response to continuous whole-body irradiation, 18: 19593
BRAMBEL, Frances D., Hemopoietic response to continuous whole-body irradiation, 18: 19593
BRAMHAM, P., Matching of waveguide coupler for r-f separator deflecting structure, 18: 20679 (CERN-64-14)
BRAMI-DEPAUX, B., Electrons in antinucleon annihilation stars, 18: 20928
BRANCA, Guido, Behavior of clay materials passing radioactive solutions, 18: 21696
BRAND, M., Survival of skin homografts in mice with bacterial infection, 18: 19511
BRAND, Marvin, Mortality of sublethally x-irradiated mice, 18: 19727
BRANDMAIER, H. E., Investigation of Hall propulsor characteristics, 18: 21391
BRANDT, D. C., Nickel plating fuel elements, 18: 20453 (HW-72415)
BRAUN, Dietrich, Polymerization of α-methylstyrene by electron irradiation, 18: 20070
BRAUN, W. G., Vortex stabilization of arc discharge, 18: 21495
BRAUNSTEIN, J., Association of Ag(I) and chloride in molten Cs nitrate, 18: 19975
BRAY, J. A., Removal of impurities from liquid metal systems, 18: 21657
BRAY, R. W., Characteristics of irradiated pork. I., 18: 19616
BRAY, R. W., Characteristics of irradiated pork. II., 18: 19617
BRDAR, Branko, Restoration of viability of x-irradiated L-strain cells, 18: 19783
BRECHER, George, Hemopoietic response to continuous whole-body irradiation, 18: 19593
BREDAEL, I., Device for determination of purity of reactor-grade materials, 18: 20281 (EUR-523.f)
BREDEMEYER, Antoine, Prog. rpt. on radiation thresholds for chorioretinal burns, 8/1/60–1/15/63, 18: 19547 (AMRL-TDR-63-71)
BREDEMEYER, Hans G., Prog. rpt. on radiation thresholds for chorioretinal burns, 8/1/60–1/15/63, 18: 19547 (AMRL-TDR-63-71)
BREISMEISTER, Fred C., Weld heat-affected zone in A-212-B steel, 18: 20529 (TID-20463)
BREITWIESER, Roland, Relation of ion and electron emission to diode diagnostics, 18: 20842
BRENNER, H., Interaction of electron beam with inhomogeneous plasma, 18: 21453
BRESCIANI, Francesco, Cell generative cycle in normal, hyperplastic and neoplastic mammary gland, 18: 21701 (BNL-7925)
BREWER, D. F., Properties of He-3 near the melting curve, 18: 20807
BREY, Wallace S., Jr., NMR studies of adsorption on metal oxides, 18: 20632 (TID-18689)
BREZNYAK, E. J., Prog. rpt. on tungsten forging, 5/19–8/19/63, 18: 20447 (ASD-TR-7-797(IX))
BRIFFOD, G., Instabilities in a reflex discharge, 18: 21503
BRILL, O. D., Cross section of $T(d,n)^4He$ and $D(d,n)^3He$, 18: 21218
BRINDLEY, J. H., Vibration studies of large SGR fuel element, 18: 21615 (NAA-SR-Memo-9164)
BRINKMAN, R., Radiomimetic toxicity of ozonized air, 18: 19538
BRITTON, R. B., Electrical breakdown between sphere and plane in

vacuum, 18: 20138
BRODER, D. L., Cross sections for excitation of levels of Mg, Cr-52, Ni-58, Ni-60, and Nb-93, 18: 21217
BRODER, D. L., Three-rotor mechanical neutron chopper, 18: 20388
BROIDO, J. H., Analysis of multicell networks, 18: 20884
BROJDO, S., Tunnel diode single-channel pulse-height analyzer, 18: 20302
BRONZAN, John B., Overlapping resonances in dispersion theory, 18: 21044
BROOKS, H. B., Design of NAA-62-2, 18: 21614 (NAA-SR-Memo-8017)
BROS, J., Four-point function in momentum space, 18: 21037
BROSZIEWICZ, R., Work safety conditions with closed radiation sources, 18: 20260
BROUILLARD, F., Runaway electrons in toroidal discharges, 18: 21533
BROWN, G. A., Prog. rpt. on energy conversion, 9–11/63, 18: 20834 (NP-13808)
BROWN, James Barrett, Prevention and treatment of radiation-induced cancer, 18: 20241
BROWN, James D., X-ray absorption and emission, 18: 19862
BROWN, Laurie M., Three-pion decay modes of η- and K mesons, 18: 21021
BROWN, Nicholas Albert, Level structure of Sc-41, 18: 21338
BROWN, R. L., Fast-slow coincidence system, 18: 20345
BROWN, Raymond J., Fabrication of commercial BeO ceramics, 18: 20462
BROWN, Ronald E., Proton spin flip and substate excitation in inelastic scattering, 18: 21252
BROWN, W. K., Energy range of He-3 neutron spectrometer, 18: 20359
BRUCE, F. M., Static breakdown voltage of uniform-field spark gaps, 18: 20602
BRUCE, W. R., Radiation sensitivity of transplanted lymphoma cells, 18: 19671
BRUECK, A., Determination of Co content of solution, 18: 19842 (EUR-581.f)
BRUECKNER, Keith A., Single-particle potential in nuclear matter, 18: 21287
BRUNBERG, E.-A., Earth's radiation belts and the aurora, 18: 21087
BRUNBERG, E.-A., Production of high-energy particles in sun and solar system, 18: 20723
BRUNELLI, B., Breakdown in a theta-pinch apparatus, 18: 21525
BRUNFAUT, Maximilienne, Effects of x rays on RNA of HeLa cells, 18: 19599
BRUNHART, G., Hyperfine field in Gd metal, 18: 21164 (CONF-481-36)
BRUNISHOLZ, G., Separation of rare earths. XI., 18: 20108
BRUNNER, Janet M., Cross sections for reactor analysis, 18: 21551 (GEMP-283)
BRUSH, S. G., Calculation of continuous integrals by Monte Carlo method, 18: 21737 (UCRL-Trans-1040(L))
BRUSSEL, M. K., Scattering of 5- to 15-Mev protons from Be-9, 18: 21362
BRYANT, J. F., Power output of thermionic cells, 18: 20871
BRYUKHANOV, V. A., Mössbauer effect on Sn-119 in Au, Pt, and Tl matrices, 18: 20007
BUBNER, M., Synthesis of α-DL-alanine-2-C^{14}, 18: 20033
BUCHER, E., Structure and electronic properties of Nb–Ru alloys, 18: 20557
BUCHET, G., Study of prebreakdown discharge, 18: 20145
BUCHSBAUM, S. J., Electron ionization frequency in D, 18: 21510
BUCINA, I., Making use of binary mixtures, 18: 20069
BUCKA, H., Nuclear quadrupole moment of Rb-87, 18: 21314
BUCKEL, Werner, Superconductivity of the Zr–Rh alloy, 18: 21104
BUCKEL, Werner, Superconduction of Ga at high pressures, 18: 21108
BUCKMAN, R. W., Jr., Prog. rpt. on Nb and Ta alloy tubing, 3/62–5/63, 18: 20487 (WANL-PR-(N)-002)
BUDAGOV, Yu. A., Bubble chamber in magnetic field, 18: 20389
BUDKA, Alfred J., GRATIS—program for calculating γ transmission, 18: 21544 (BRL-Memo-1223)
BUDZANOWSKI, A., Reaction (d,^{3}He) on S nuclei, 18: 21210 (PAN-288)
BUEHRING, Wolfgang, Electron polarization for β decay of Bi-210 and P-32, 18: 21324
BUKATA, R. P., Anisotropy of primary cosmic radiation at the earth, 18: 20819
BULAT, M., Effect of cystamine on urinary excretion of 5-hydroxyindole-acetic acid in x-irradiated rats, 18: 19639
BULATOVA, R. F., Isotopic effects in structural properties of H isotopes, 18: 20008
BULLIS, R. H., Cesium ion-atom collision cross sections, 18: 20772
BULLIS, R. H., Prog. rpt. on collision probabilities of electrons and Cs ions in Cs vapors, 1/62–1/63, 18: 21379 (N63-13602)
BULLOUGH, R., Elastic energy of Rhombus-shaped dislocation loop, 18: 20547
BUNKER, M. E., Observation of the 1/2+ (411) orbital in Ho-165, 18: 21162 (CONF-481-3)
BUNKIN, F. V., Excitation and ionization of atoms in strong radiation field, 18: 20770
BURCH, P. R. J., Leukemogenesis in man, 18: 19579
BURDICK, E. E., Predicting excess reactivity in the ETR, 18: 21685
BURDITT, R. B., Effect of explosive impacting on U, 18: 20535 (Y-1455)
BURGER, Tibor, Blood volume changes after P-32 therapy, 18: 19661
BURHOP, E. H. S., Recent experiments with nuclear emulsions, 18: 20966
BURKHARDT, W., Coaxial-symmetrical flow spark counter, 18: 20348
BURLEY, Harvey A., Nuclear techniques for product improvement, 18: 20425
BURMEISTER, H., Electron-photon cascades according to Monte Carlo method, 18: 21322
BURNS, F., Fast neutron activation analysis for O in metals, 18: 19922
BURNS, W. G., Radiation chemistry of hydrocarbons. X., 18: 20055
BURROWS, Bolton A., Corrections for two-crystal whole-body counter, 18: 20337 (NYO-2553-1)
BURROWS, J. R., Boundary of the outer radiation zone, 18: 21071
BURYAKOVSKII, G. Yu., Stationary radiation of homogeneous system in multimode resonator. I., 18: 20310
BUSCH, C. W., Pressure wave generated in fissionable gas by neutron irradiation, 18: 21268
BUSCH, G., g-Factor of 155-kev 2 level of Os-188, 18: 21244
BUSCH, Manfred, Importance of penumbra for irradiation fields, 18: 19833
BUSEV, A. I., 1-Mercaptopropionic acid derivatives in analytical chemistry. III., 18: 19914
BUSH, Elizabeth T., Liquid scintillation counting of doubly labeled samples, 18: 19873
BUSH, R. S., Radiation sensitivity of transplanted lymphoma cells, 18: 19671
BUSINARO, T., Fail-safe circuits for nuclear protective systems, 18: 21580
BUTAYE, Michel, Separation of tracer for radiochemical analysis of Ra-226, 18: 19840 (CEA-R-2419)
BUTKOVICH, Theodore R., Shock wave from underground nuclear explosion in granite, 18: 20125 (UCRL-7762)
BYAKOV, V. M., Formation of molecular products in H_2O radiolysis, 18: 20050
BYERS, N., Invariant variables for n particles, 18: 21305
BYSIEK, M., Gamma radioactivity of building materials, 18: 20210 (CLOR-20)

C

CACCIARI, I., Succinic thiokinase and succinic dehydrogenase of *Rhodotorula gracilis* as influenced by tritiated water and cystamine, 18: 19786
CAIRNS, R. C., Coated fuel particles for BeO-based fuels, 18: 20570
CAIRNS, R. C., Reprocessing of BeO-based fuels, 18: 20116
CALIS, Michelino, Method of manufacturing porous barriers, 18: 20437
CAMERON, L. M., Differential cross sections for triton-induced reactions on N-14, 18: 21282
CAMERON, Sheilagh A., Strontium into precipitates of Ca fluoride and phosphate, 18: 19949
CAMPBELL, A. E., Molybdenum as an electrode material for thermionic converters, 18: 20865
CAMPBELL, Evan E., Bibliography on chemical detectors, 18: 19847 (LAMS-2378(Vol.II))
CAMPBELL, John A., Exposure control in cineradiography, 18: 19829
CAMPBELL, Patricia A., Spectrophotometric determination of perchlorate, 18: 19843 (IS-658)
CAMPBELL, William J., X-ray absorption and emission, 18: 19862
CANDES, Pierre, Control panel for radiation around reactors, 18: 21562 (CEA-R-2401)
CANTARANO, S., Intense artificial radioactivity in autumn 1962, 18: 21082
CANTARELL, I., Detection attempts for α particles during irradiation with thermal neutrons, 18: 20403
CAPELLEN, Jennings, Isotopic composition of V from organic sources. I.,

18: 19519 (IS-655)
CAPPELLANI, F., Silicon surface-barrier detectors, 18: 20354
CAPPS, Richard H., Octet mass vector, 18: 20939
CAPRINO, G., Effect of propylthiouracil in the totally irradiated animal, 18: 19780
CAPRINO, G., Recovery in totally irradiated animals, 18: 19779
CARABATEAS, E. N., Current-voltage characteristics of Cs converters, 18: 20849
CARABATEAS, E. N., Prog. rpt. on energy conversion, 9–11/63, 18: 20834 (NP-13808)
CARERI, G., Fermi international school of physics, 7/61. Course XXI. Liquid He, 18: 20789
CARERI, G., Ions in liquid He, 18: 20805
CAREY, Mark A., Preparation, properties, and uses of WO_3, 18: 19879
CAREY, W. T., Effect of explosive impacting on U, 18: 20535 (Y-1455)
CARLILE, Robert Nichols, Microwave propagation in plasma waveguide, 18: 21444
CARLSON, T. A., Ionization of Kr by x rays, 18: 20730 (CONF-481-7)
CARLSON, Thomas A., Atomic readjustment to inner shell vacancies in Ne and Ar, 18: 20729 (CONF-481-6)
CARLSSON, Carl, Flash roentgen tubes, 18: 20308
CARMONY, D. Duane, Properties of Ξ hyperons, 18: 20959
CARNAHAN, D. R., Refractory alloys, 18: 20485 (ASD-TDR-62-670(Pt.II))
CAROLI, C., Coherence length and penetration depth of dirty superconductors, 18: 21105
CARON, Paul R., Self-quenching cylindrical discharges, 18: 21475
CARPENTER, John Morland, Prediction and measurement of neutron chopper burst shapes, 18: 20339 (TID-20504)
CARRIGAN, P. H., Jr., Fate of radionuclides released to surface stream, 18: 21697
CARROLL, A. S., Measurement of neutron-proton polarization at 126 Mev, 18: 20934
CARROLL, Benjamin E., Cancer mortality patterns among U miners and millers, U. S., 18: 20256
CARSTEN, Arland L., Effects of partial-body irradiation on delayed responses, 18: 19586
CARTER, J. W., Prog. rpt. on effect of impurities of Cs fuel upon ion engines, 12/63–2/64, 18: 20626 (NP-13800)
CARUSO, A., Model for low-pressure discharge near limiting current, 18: 21467
CASE, K. M., Approximation method for diffraction problems, 18: 20657
CASPER, Karl J., Decay of 5.4-d Pm-148, 18: 21262
CASS, Levi Aldrich V., Theory of MHD free surface waves, 18: 21445
CASSELS, J. M., Counters at the CERN proton synchrotron, 18: 20401
CASSIDY, R. B., Detection of adsorbant saturation by radioisotopic analysis, 18: 21553 (NAA-SR-Memo-7771)
CASTANO Y ALMENDRAL, Alfonso, Walker carcinomas after single irradiation with Co-60, 18: 19699
CASWELL, Bruce F., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
CASWELL, Bruce F., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
CATANZARO, E. J., Sr-87/Sr-86 ratios in Hawaiian lavas, 18: 20216
CAUDILL, H. L., Waste management program, 18: 21691 (HW-77163)
CAUGHLAN, Georgeanne R., Combined H- and He-burning in red giant star, 18: 20727
CAULFIELD, H. J., Film collectors for thermionic converters, 18: 20870
CAUTHEN, Lewis J., Jr., Effects of seismic waves on structures, 18: 20127 (UCRL-7773)
CAVALIERE, A., Model for low-pressure discharge near limiting current, 18: 21467
CAVULEA, O., Serotonin in pathogeny of hemorrhagic syndrome in radiation sickness, 18: 19696
CAYLESS, M. A., Resonance radiation reflection, 18: 21464
CENCE, Robert J., High-resolution γ spectrometry, 18: 20342 (UCRL-10781)
CERANIC, Tatjana, Production and use of tritium, 18: 20431
CERBONE, R., Energy-dependent extrapolation length in polyethylene, 18: 21132 (RPI-328-4)
CESARI, F., Maximum credible accident and requirements in choice of containers for nuclear power plants, 18: 21647
CESTER, R., Study of the $K_{\mu 3}$ decay spectrum, 18: 20961
CHACE, W., Shunting mechanisms in exploding wires, 18: 21536
CHACE, William G., Vaporization in exploding wires, 18: 21535
CHALMERS, Robert Anton, Polarization of protons scattered from deuterons, 18: 21008
CHAMBERLAIN, O., Liquid-H Cherenkov counter, 18: 20369
CHAND, Ramesh, s-Wave $\bar{K}$-nucleon interactions, 18: 21020
CHANDHOK, V. K., High-strength, elevated-temperature, corrosion-resistant steel, 18: 20446 (ASD-TDR-63-766)
CHANDRASEKHAR, S., Hydromagnetic problems bearing on geomagnetism, 18: 20621 (AFCRL-62-1075)
CHANG, G. T., FIRED—(integer data relative read), 18: 20439 (NAA-SR-Memo-9683)
CHANG, Gwendolynne T., DAND—Dandurand least square routine, 18: 21710 (NAA-SR-Memo-9638)
CHANG, Howard, Hose instability of finite, pinched, relativistic, electron beam, 18: 21541
CHANG, I., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
CHANG, Li-ning, Radiative capture of μ mesons, 18: 21310
CHANG, N. P., Feinberg-Pais theory of weak interactions. II., 18: 20950
CHANG, Z. S., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
CHANTRY, P. J., Interpretation of experiments on dissociative attachment ionization of molecules, 18: 19993
CHAPMAN, R. A., Film collectors for thermionic converters, 18: 20870
CHAPMAN, Thomas Edwin, Improvements relating to finned metal tubing, 18: 20506
CHARLESBY, A., Radiation protection of aqueous polyvinylpyrrolidone solutions by thiourea, 18: 20056
CHARLESTON, Donald B., Techniques which aid in quantitative interpretation of scan data, 18: 19835
CHARPIN, Jean Edouard, Method of manufacturing porous barriers, 18: 20437
CHASE, P. E., Krypton-85 uptake of the human brain, 18: 19522
CHASTAIN, Joel W., Shielding studies on salt slabs, Gd, and water, 18: 21543 (BMI-1384)
CHATTERJEE, S. D., Influence of radial thermal gradient in Geiger counter, 18: 20404
CHATTERTON, P. A., Multiplate electrostatic particle separator, 18: 20680 (NIRL/R/49)
CHAUDHRI, M. Munawar, Emission of uv from metals, 18: 20781
CHAUDHRI, Rafi Mohammad, Emission of uv from metals, 18: 20781
CHEN, Chun-hsien, Problems in theory of superconductivity, 18: 21107
CHEN, En-chih, Direct production of electron pairs by high-energy charged particles, 18: 21311
CHEN, Francis F., Low-frequency instabilities of a fully ionized gas, 18: 21505
CHEN, R. L. W., A-c conductivity of plasma, 18: 21380 (NASA-TM-X-50732)
CHEN, Shih-kan, Problems in theory of superconductivity, 18: 21107
CHENG, Hwo-Sheng, Chromatographic columns for rare-earth separation, 18: 20109
CHENTSOV, N. N., Calculation of continuous integrals by Monte Carlo method, 18: 21737 (UCRL-Trans-1040(L))
CHERNIKOVA, D. M., Fourth sound in He^3–He^4 solution, 18: 21115
CHESTER, G. V., Superfluidity, 18: 20791
CHESWORTH, R. H., Staffing of the ML-1 power plant, 18: 21655
CHEW, Geoffrey F., Maximal analyticity of second degree, 18: 20917 (UCRL-10786)
CHILASHVILI, G. A., Hypertritium binding energy in case of nonlocal interaction, 18: 21182 (JINR-P-1579)
CHING, Lin-chong, Beta spectrometer with intermediate image, 18: 20405
CHIPMAN, John, Free energies of formation of V, Nb, and Ta carbides, 18: 19970
CHIRKOVSKII, V. I., Effects of γ irradiation of seeds on development of nicotiana plants, 18: 19690
CHIU, Hong-yee, Surface x-ray emission from neutron stars, 18: 20711
CHOITZ, H. C., Studies of body water and water turnover, 18: 19530
CHOU, Yueh-shua, Beta spectrometer with intermediate image, 18: 20405
CHRISTENBERRY, K. W., Late somatic effects of x radiation in mice, 18: 19796
CHRISTENSEN, C. J., Beta decay of the neutron, 18: 21128 (KR-64 (Sect.XXVI))

CHRISTENSEN, C. J., Neutron half-life experiments, 18: 21139 (KR-64 (Sect.XXVII))
CHRISTENSEN, C. J., Theory of β decay, 18: 21187 (KR-64(Sect.IV))
CHRISTIAN, J. E., Analysis of organically bound I, 18: 19877
CHRISTIE, G. E., Fabrication of fueled BeO, 18: 20497
CHRISTY, Robert F., Calculation of stellar pulsation, 18: 20716
CHU, C. K., Magnetohydrodynamic flow past nonconducting walls, 18: 20650
CHU, Chong-wei, Motion of magnetically confined plasma cylinder, 18: 21538
CHU, W. T., Particles with a charge of ⅓ e, 18: 20952
CHUBB, W., Properties and heat treatment of Zr–U alloys, 18: 20449 (BMI-973(Del.))
CHUMAK, M. G., Radiation effects on mitotic cycle of cornea and intestine epithelia, 18: 19689
CHUPRINA, V. G., Oxidation of Ni_3Al–Ni_3Nb alloy systems, 18: 20478
CHURCHILL, R. F., Axial streamers in the Z-pinch, 18: 21531
CHUTE, J. H., Damage in neutron-irradiated BeO, 18: 20610
CLAASSEN, Howard H., Chemistry of the noble gases, 18: 19997
CLARE, T. E., Cold pressing and sintering of BeO, 18: 20502
CLARK, R., Release of Xe-133 on heating of UO_2–ThO_2–BeO, 18: 20572
CLARKE, F. J. P., Growth of neutron-irradiated MgO, 18: 20597
CLARKE, J. D., Triggering of undervolted spark gaps, 18: 20149
CLARKE, John T., Surface area measurement of graphite using Kr-85 γ radiation, 18: 19971
CLAY, D., Measurement of the rate for $\mu^- + He^3 \rightarrow H^3 + \nu$, 18: 21160 (CONF-231-5)
CLEALL, J. F., Effects of Sr-90 and x radiation on rat teeth, 18: 19655
CLEMENT, M., Experimental study of an r-f Ar torch, 18: 21517
CLEMETT, Colin J., Dielectric behavior of H_2O and D_2O in dioxane, 18: 19957
CLEVER, H. L., Thermodynamics of La and Nd hexaborides, 18: 19928 (CONF-405-6)
CLIFFORD, A. E. S., Nuclear installations act, 18: 20247
CLIFTON, Kelly H., X irradiation of the tumor bed, 18: 19695
CLOUSER, Paul L., Millimeter-wave molecular-beam spectroscopy, 18: 19990
CLOUTIER, G. G., Microwave measurements of finite plasmas, 18: 21368 (AFCRL-63-161)
COCCHI, Fiametta, Radiolysis of 2,2,4-trimethylpentane with γ rays from Co-60, 18: 20079
COCCHI, M., Extrapolated radius and height calculation for cylindrical reactor, 18: 21550 (EUR-1624.e)
COCHRAN, George W., Prog. rpt. on cell-free synthesis of TMV, final, 3/63–2/64, 18: 21725 (TID-20437)
COGAN, Edward, Separation of rare earth metals in Zr–rare earth alloys, 18: 19839 (BM-RI-6430)
COHEN, Marvin L., Superconductivity in semiconducting $SrTiO_3$, 18: 21102
COHEN, P., Chemical shim control for reactors, 18: 21652
COHEN, P. J., Krypton-85 uptake of the human brain, 18: 19522
COHEN, R. L., Nuclear hyperfine structure in Er-166, 18: 21272
COLE, J. K., Spark gap development, 18: 21717 (SC-R-64-119)
COLE, Leonard J., Chromosone changes following irradiation in mammals, 18: 19583
COLEMAN, John, Quantum cell model for hard spheres, 18: 21053
COLEMAN, Sidney, Mixing of elementary particles, 18: 20947
COLEMAN, Sidney, Theory of strong interaction symmetry breakdown, 18: 20941
COLIN, R., Vaporization of sulfides of Ca, Sr, and Ba, 18: 19939 (WADD-TR-60-782(Pt.XXI))
COLLIN, Robert L., Preparation and properties of two Sr orthophosphates, 18: 19954
COLLINS, C. B., Helium afterglow. I., 18: 20737
COLLINS, C. B., Helium afterglow. II., 18: 20738
COLLINS, Gordon D., Practical aspects of Na system reliability, 18: 20194
COLLINS, J. C., Application of university code of practice, 18: 20245
COLLINS, L. E., Extraction of high-current ion beams, 18: 20741
COLLINS, W. G., Jr., Triple-scattering parameter D_t in the free n-p system at 170°, 18: 20933
COLLOMBY, Jean, Progression of uhf discharge in rarefied gas, 18: 21511
COLMAN, Robert, Effect of lanthanides and actinides on blood coagulation. I., 18: 19535
COLMAN, Robert, Effect of lanthanides and actinides on blood coagulation. II., 18: 19536
COLOMBO, R. L., Comparison between steam-sintering and H sintering of UO_2 pellets, 18: 20489
COMPANION, A. L., Optical energy gap of Sc oxide, 18: 19986
CONE, A. F., Quality surveys from vendor's point of view, 18: 21718 (SC-R-64-135)
CONFORTO, A. M., Intense artificial radioactivity in autumn 1962, 18: 21082
CONGDON, C. C., Effect of thymus transplantation on radiation chimeras, 18: 19766
CONGDON, C. C., Late somatic effects of x radiation in mice, 18: 19796
CONKLIN, J. W., Myeloid leukemia in the mouse, 18: 19577
CONSOLI, T., Experimental study of an r-f Ar torch, 18: 21517
CONSOLI, T., Non-controlled h-f discharges by scattering region, 18: 21508
CONTI, L., Fail-safe circuits for nuclear protective systems, 18: 21580
CONTI, M., Fail-safe circuits for nuclear protective systems, 18: 21580
CONWAY, D. C., Nuclear spectroscopy and reaction kinetics, 18: 20023 (TID-20510)
COOK, C. W., Delayed γ rays from photofission of U-238, U-235, and Th-232, 18: 21298
COOK, J. R., Photosynthetic activity during division cycle in synchronized *Euglena gracilis*, 18: 21721 (TID-18753)
COOK, P. A., Cross section for process $K^- + d \rightarrow \bar{K}^0 + 2n$, 18: 20926
COOK, R. F., ESR spectrometer for use while irradiating wet biological systems, 18: 20293
COOPER, C. Burleigh, Neutral Ca and Ca, sputtered from polycrystalline Ca, 18: 20811
COOPER, Edwin L., Effects of x irradiation on survival of scale homografts, 18: 19726
COOPERMAN, Edward Lee, Uranium-235 fission in coincidence with prompt-fission γ rays, 18: 21343
COPIC, M., Anisotropy of diffusion constant in media with empty channels, 18: 21141
COPPI, Bruno, Stabilization of plasma dissipative modes, 18: 21415
CORBIN, Tommy R., Neutron and α counters for heavy-element column chemistry, 18: 20101 (UCRL-11300)
COREY, K. R., Total-body scanning, 18: 19818
CORINALDESI, E., Outline of perturbation theory of H molecule. III., 18: 20743
CORMACK, A. M., Small-angle nuclear scattering experiments, 18: 21242
CORNGOLD, Noel, Transient phenomena in thermalization. I., 18: 21142
CORNGOLD, Noel, Transient phenomena in thermalization. II., 18: 21143
CORRENS, H. J., Diagnosis of tumors of eye with radioactive phosphorus, 18: 19823
CORRENS, H. J., Early uptake measurements and radiation dose in the radioiodine test, 18: 19822
COSACK, M., Reaction $F^{19}(d,n)Ne^{20}$, 18: 21241
COSGROVE, G. E., Late somatic effects of x radiation in mice, 18: 19796
COSGROVE, Gerald E., Lethally irradiated F_1 hybrids, 18: 19770
COTTINGHAM, W. B., Electron ionization frequency in D, 18: 21510
COTZIAS, [G. C.], Manganese, melanins, and extrapyramidal system, 18: 21700 (BNL-7855)
COUBLE, E. C., Be-7, P-32, P-33, and S-35 stratospheric concentrations, 18: 21080
COUGHLEN, C. P., Effect of explosive impacting on U, 18: 20535 (Y-1455)
COULTER, A. G., Dissociation in H low-voltage arc, 18: 21466
COUTANT, J., Annular source of ions in crossed fields, 18: 20155
COWLEY, R. A., Phase transitions of Sr titanate, 18: 19992
CRAGG, D. G., Fabrication of fueled BeO, 18: 20497
CRAIG, P. P., Liquid He-II heat conductivity and fountain pressure, 18: 20798
CRAIG, P. P., Surface superconductivity in type I and type II semiconductors, 18: 21101
CRANSTON, F. P., Jr., Observation of the 1/2+ (411) orbital in Ho-165, 18: 21162 (CONF-481-3)
CRAVAROLO, L., Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)
CRAWFORD, Frank S., Jr., Absolute decay rate for $K_2^0 \rightarrow \pi^0 + \pi^- + \pi^0$,

18: 20956
CRAWFORD, Gordon Bradley, Diffusions and Poisson collections, 18: 20442
CREMIEU-ALCAN, E., Proceedings of the 6th international conference on ionization phenomena in gases, Paris, 7/63. Vol. II., 18: 20671
CRITOPH, E., Effective cross sections for U-235 and Pu-239, 18: 21167 (CRRP-1191)
CRITTENDEN, R., K⁻-p elastic scattering at 2.00 Bev/c, 18: 20954
CRONKITE, E. P., Fate of H^3-thymidine-labeled bone-marrow cells in irradiated recipients, 18: 19769
CRONKITE, Eugene P., Autologous bone-marrow transfusion following chemotherapy, 18: 19768
CRONKITE, Eugene P., Effects of whole-body irradiation on human marrow, 18: 19602
CRONKITE, Eugene P., Enigmas underlying the study of hemopoietic cell proliferation, 18: 19504 (BNL-7839)
CRONKITE, Eugene P., Extracorporeal irradiation of blood lymphocyte proliferation, 18: 19548 (BNL-7926)
CRONSON, Harry Marvin, Plasma electron temperature in strong electric field, 18: 21447
CROOK, Robert Derek, Improvements in production of Be, 18: 20466
CROSS, A. M., Viability of frozen and stored bone marrow, 18: 19805
CROUTHAMEL, C. E., First observation of solution of Li_3Bi, 18: 19978
CROWFIELD, Frederic R., Interaction of plasma oscillations with conduction in a Penning gauge, 18: 21507
CROZY, Alan, Cosmic dust, 18: 20720
CSOEMOER, Sandor, Investigation of cervix carcinoma, 18: 19701
CULP, A. W., Jr., Control of fast reactors, 18: 21561 (APEX-603(Del.))
CUMMINS, J. D., Errors and signal-to-noise ratio of binary cross-correlation measurements of system impulse response, 18: 20278 (AEEW-R-329)
CUMMINS, J. T., Ionic relationships of bioelectrogenic mechanism in isolated rat stomach, 18: 19521 (USNRDL-TR-716)
CURRIE, B. W., Atmospheric waves from U.S.S.R. explosions, 18: 21072
CURTIS, Howard J., Somatic mutations and carcinogenesis, 18: 19505 (BNL-7912)
CURZON, F. L., Axial streamers in the Z-pinch, 18: 21531
CUTSHALL, Norman, Radioactive particle in sediment from the Columbia River, 18: 20219
CZEIZEL, Endre, Effects of irradiated bone marrow on liver regeneration of rats, 18: 19790
CZEIZEL, Endre, Question of radiotoxins, 18: 19653
CZEKAJEWSKI, J., Distribution of charged particles in aurorae, 18: 20364

D

DAANE, A. H., Magnetic properties of intra-rare earth alloys, 18: 20519 (IS-551)
DAANE, A. H., Phase systems Y–Nd and Sc–Nd, 18: 20520 (IS-841)
DABROWSKI, Janusz, Single-particle potential in nuclear matter, 18: 21287
DAEHNICK, W. W., Spin dependence of $(d,t)\,l_n = 1$ angular distributions in Ni and Fe, 18: 21301
DAHL, Lewis K., Role of salt and genetics in hypertension, 18: 21702 (BNL-7971)
DAHL, Orin I., Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
DAI, Yuan-hang, Radiative capture of μ mesons, 18: 21310
D'ALAGNI, M., Solid-state polymerization of trioxane, 18: 20032
DALE, P. P., Effects of Sr-90 and x radiation on rat teeth, 18: 19655
DALEAS, R. S., Salt velocity technique, SNAP-8, 18: 21671 (NAA-SR-Memo-9232)
DALGARNO, A., Thermal reactions involving charged particles, 18: 21092
DAMASK, A. C., Point defects in metals, 18: 20568
DANIEL, H., Construction of $\pi\sqrt{2}$ spectrometer and investigation of conversion line spectra of In-114m, 18: 21313
DANOS, Michael, Giant resonances in heavy nuclei, 18: 21206 (NP-13813)
DARRAH, J. G., Emitter work function in arc-mode thermionic converters, 18: 20867
DARRIULAT, P., Scattering of 65-Mev He ions from O-16, 18: 21260
DAS, Amio R., Liquid-solid transformation kinetics in Al_2O_3, 18: 20534 (UCRL-11166)
DAS, T. P., Theory of core-electron contributions to hyperfine interactions, 18: 20749
DAS GUPTA, S., Axial asymmetry in some nuclei, 18: 21225
DASHEN, Roger F., Theory of electron backscattering, 18: 20943
DATES, L. R., Safety rpt. on ZPR-VI, 18: 21592 (ANL-6271)
DATZ, S., Ionic bombardment of metallic surfaces, 18: 20783
DAUVILLIER, A., Cosmic dust, 18: 20720
DAVID, G., Change of function of suprarenals with acute radiation injury, 18: 19676
DAVID, H., Ultrastructure of variant of Furth mice mastocytoma, 18: 21732 (ANL-Trans-7)
DAVIES, A. J. S., Viability of frozen and stored bone marrow, 18: 19805
DAVIES, D. E., Ionization phenomena in Hg vapor, 18: 21476
DAVIES, D. E., Ionization coefficients in H, He, and Ne, 18: 21477
DAVIES, D. Kenneth, Ionization in He, 18: 21472
DAVIES, J. A., Range of Xe-125 ions in Si, 18: 20812
DAVIES, P. G., Field emission from semiconductors, 18: 20152
DAVIS, Ann A., Gonadal dosages in investigative radiography, 18: 20264
DAVIS, Briant L., Critical end point for Ce I and Ce II, 18: 20551
DAVIS, R., Jr., Temporal and spatial variation in cosmic rays, 18: 20815 (BNL-7948)
DAVIS, W., Jr., Properties and cleanup of degraded TBP–Amsco solutions, 18: 20100 (ORNL-3524)
DAVY, P., Impedance of electric discharge, 18: 21459
DAWSON, B., Structure of BeO, 18: 20575
DAWSON, John Frederick, Nucleon-nucleon interactions inside light nuclei, 18: 21345
DAWSON, P. H., Positive ions in CO_2 glow discharge, 18: 21455
DAYTON, B., Electrons in the galactic cosmic radiation, 18: 20826
DAYTON, Russell W., Prog. rpt. on civilian applications, 1/64, 18: 20450 (BMI-1661(Del.))
DEALY, James B., Jr., Hematological responses to whole-body irradiation, 18: 19584
DEAN, P. J., Electronic excitation of diamond, 18: 20746
DE ANGELIS, A., Interferometric study of a r-f discharge, 18: 21512
DEANOVIC, Z., Effect of cystamine on urinary excretion of 5-hydroxyindoleacetic acid in x-irradiated rats, 18: 19639
DEANOVIC, Z., Relationship between dose of x irradiation and urinary excretion of 5-hydroxyindoleacetic acid in rats, 18: 19626
DEARNALEY, G., Lithium-drifted Si surface-barrier detector, 18: 20355
DE BOER, J., Excitation model for liquid He-II, 18: 20790
DE BRUYN OUBOTER, R., Dilute mixtures of He-3 in superfluid He-4, 18: 20801
DECOURTYE, L., Effect of radiation on apple tree chimera, 18: 19567
DE COURVILLE, J. Bernard, Formation of disruptive discharges in gas, 18: 21494
DEDKOV, Yu. M., Color reactions of Nb ions with certain reagents, 18: 19913
DEEM, H. W., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
DEEM, H. W., Thermodynamic and transport properties of K, 18: 20018
DEFFNER, U., Detection of free radicals in irradiated fats, 18: 20086
DE GAUDEMARIS, G. P., Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
DE GENNES, P. G., Coherence length and penetration depth of dirty superconductors, 18: 21105
DE GORSKI, E., Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
DE HAAN, W., CAPRI A.B.—IBM 7090 thermal utilization factor calculation program on ring method, 18: 21597 (EUR-1606.e)
DEKHTYAR, I. Ya., Solid-state diffusion in metals and alloys, 18: 20536 (AEC-tr-6313)
DELAUNAY-OLKOWSKY, J., Absolute photopeak efficiency for well-type NaI(Tl) crystal, 18: 20076
DELAVIGNETTE, P., Interlamellar compounds of graphite with Br, ICl, and $FeCl_3$, 18: 19931 (EUR-542.e)
DELGROSSO, E. J., Determination of effects of low pressure oxidation, 18: 20480
DELIC, V., Uranium in the urine of miners, 18: 20271
DELLA PORTA, Paolo, Symposium on residual gases in electron tubes, Milan, 3/63, 18: 20305
DELLE SITE, Alessandro, Radiochemical polymerization of phenylacetylene, 18: 20052

DELORME, C., Construction of spark chamber with transparent metal mesh, 18: 20370
DELYAGIN, N. N., Mössbauer effect on Sn-119 in Au, Pt, and Tl matrices, 18: 20007
DEMANGE, Ph., Nuclear vapotron, 18: 21617 (TID-7694(p.71-84))
DEMIRKHANOV, R. A., Plasma equilibrium in space-periodic magnetic field, 18: 21434
DEMIRKHANOV, R. A., Source of high-intensity protons, 18: 20690
DEMKOV, Yu. N., Detachment of electrons in slow collisions between negative ions and atoms, 18: 20771
DEMOS, J. R., Neutron-produced prismatic dislocations in Cu, 18: 20599
DEMPSTER, W. J., Radiation effects on survival of skin homografts, 18: 19605
DENGEL, Ottmar, Diffusion of protons (tritons) in ice crystals, 18: 20963
DENHOLM, A. S., Electrical breakdown between sphere and plane in vacuum, 18: 20138
DENNOVETSKII, S. V., Investigating parameters of relaxation processes, 18: 20078
DENNY, John P., Beryllium ingot sheet, 18: 20496
DERADO, I., π^-p Interactions at 10 Bev/c, 18: 20951
DER AGOBIAN, Roger, Shock waves produced by condenser discharge, 18: 20629 (NP-13850)
DER SARKISSIAN, Michael, Study of low-energy π–λ scattering, 18: 21009
DE SANTIS, P., Solid-state polymerization of trioxane, 18: 20032
DE SANTIS, V. J., Measuring normal spectral emissivity of conductive refractory compounds at high temperatures, 18: 20567
DESHPANDE, V. K., Reaction (He^3,n) on C-12 and C-13, 18: 21259
DE SOUZA, P. D., S-wave hyperon-nucleon interactions and SU$_3$ symmetry, 18: 20913 (TID-20483)
DEVARE, H. G., Decay scheme of Te-129 isomers, 18: 21285
DEVARE, S. H., Decay scheme of Te-129 isomers, 18: 21285
DE VRIES, A. E., Inversion temperature separation of isobaric CO molecules by thermal diffusion, 18: 20435
DE VRIES, C., Inelastic electron-deuteron scattering experiments, 18: 20945
DE VRIES, R. F., Measuring time resolved electron density and ion temperature of plasmas, 18: 21384 (NP-13853)
DEWEY, D. L., Effect of protectors on *Serratia marcescens* during anaerobic x irradiation, 18: 19785
DICKE, R. H., Evolution of solar system and expansion of universe, 18: 20712
DICKEL, G., Concentration dependence of separation factor of Li isotopes in ion exchange, 18: 20434
DICKENS, J. K., Elastic scattering of deuterons from Ni-60 and Cd-114, 18: 21161 (CONF-417-26)
DICKERSON, Ronald F., Prog. rpt. on civilian applications, 1/64, 18: 20450 (BMI-1661(Del.))
DI COLA, G., Extrapolated radius and height calculation for cylindrical reactor, 18: 21550 (EUR-1624.e)
DIENES, G. J., Point defects in metals, 18: 20568
DIENSTBIER, Zdenek, Influence of combined radiation on activity of lactic acid dehydrogenase, 18: 19705
DIETHELM, Lothar, Differences of radiation injury to testes of rats, 18: 19709
DIETL, J., Nuclear resonance absorption of Fe-57 in ZnS phosphors, 18: 20003
DIETRICH, Klaus, Connection of independent-pair model with variational principle, 18: 21330
DIETRICH, W., Electron beam melting and welding in nuclear technology, 18: 20491
DILLAMORE, I. L., Stacking-fault energy of some pure f.c.c. metals, 18: 20550
DILLEY, J., Nucleon and the pion-nucleon trajectory, 18: 20948
DILLON, J. C., Calculating and contouring relative power and fuel element exposure for HNPF, 18: 21640 (NAA-SR-Memo-9391)
DI LUZIO, N. R., Palmitate-1-C^{14} metabolism in the rabbit, 18: 19665
DI MARCO, G., Succinic thiokinase and succinic dehydrogenase of *Rhodotorula gracilis* as influenced by tritiated water and cystamine, 18: 19786
DIMOND, N. A., Be-7, P-32, P-33, and S-35 stratospheric concentrations, 18: 21080
DI STEFANO, Victor, Pharmacology of radioprotectant agents, 18: 19771
DJURIC, D., Uranium in the urine of miners, 18: 20271
DOAK, K. W., Crystalline olefin polymers. II., 18: 20034
DOBBINS, Walter James, Apparatus for measuring coating amounts, 18: 20323
DOBROTIN, N. A., Information on strong interactions, 18: 20968
DOHERTY, D. G., Late somatic effects of x radiation in mice, 18: 19796
DOKTOROV, Yu. A., Problems of electric probes in high vacuum, 18: 20665
DOLINSKII, E. I., Regge poles and resonance nuclear reactions. I., 18: 21332
DOMANUS, J., Radiological protection in flaw detection, 18: 20259
DONALDSON, D. M., Chemical experience with Dounreay reactor, 18: 21661
DONDES, S., Gamma radiolysis of CO in presence of rare gases, 18: 20087
DONG, W. D., Molybdenum as an electrode material for thermionic converters, 18: 20865
DORE, Earl K., Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
DORIA, G., Transplantation antigens in mice, 18: 19589
DORLING, E. B., British space research program, 18: 21091
DORMAN, Gerald, Radiative corrections to muon and β decay, 18: 21010
DORN, D. W., Heavy isotope production by nuclear devices, 18: 20126 (UCRL-7770)
DORN, D. W., Production of transuranium elements in thermonuclear explosion, 18: 20638 (UCRL-7347)
DORN, John E., Dislocations in recovery of cold-worked Al, 18: 20533 (UCRL-10728)
DORNER, S., Oxygen evaluation in Na, 18: 19919
DOROSHENKO, G. G., Spectra of fast neutrons of Po–Be source passing through shield, 18: 21136
DOTY, D. R., Dose measurements for neutron in ducts, 18: 21546 (NP-13805)
DOUCET, H., Reflex discharge at low pressure in a radially increasing magnetic field, 18: 21499
DOUGLAS, Thomas B., Statistical model for beta Zr hydrides, 18: 19959
DOUGUET, E., Nuclear vapotron, 18: 21617 (TID-7694(p.71-84))
DOUIS, Michel, Improvements in methods of producing I-131, 18: 20436
DOURY, A., Atmospheric radioactivity near ground at French nuclear sites, 18: 20209 (CEA-2397)
DOVBENKO, A. G., Cross sections for excitation of levels of Mg, Cr-52, Ni-58, Ni-60, and Nb-93, 18: 21217
DOWD, Robert E., Asymptotic description of cusps of hydromagnetic figure of equilibrium, 18: 21387 (NYO-10435)
DOWELL, W. C. T., Demonstration of lattice planes in thin single crystals, 18: 20319
DOYLE, E. F., Flow-balancing device for BWR, 18: 21573 (NYO-10475)
DRABE, Joachim, Effects of γ radiation on growing larynx of rabbit, 18: 19700
DRAEVSKII, V. N., Turbulent diffusion of weakly ionized plasma, 18: 21425
DRAGANIC, Ivan, Radiation chemistry at "Boris Kidric" Inst., 18: 20082
DRAPCHINSKII, L. V., Probability of ternary fission of U-235 and U-238, 18: 21219
DRECHSLER, Wolfgang, Induced pseudoscalar interaction and μ capture in He-3, 18: 21326
DREICER, H., Kinetic theory of an electron-photon gas, 18: 21411
DRESSER, D. L., Analysis of capillary converter experimental results, 18: 20857
DRESSLER, E., Diagnosis of tumors of eye with radioactive phosphorus, 18: 19823
DRESSLER, E., Early uptake measurements and radiation dose in the radioiodine test, 18: 19822
DREVINSKY, P. J., Be-7, P-32, P-33, and S-35 stratospheric concentrations, 18: 21080
DRIGO, L., Polarization of protons scattered from C-12, 18: 21300
DRUAUX, J., Annular source of ions in crossed fields, 18: 20155
DRUIN, V. A., Spontaneous fission of element 102 isotope with mass number 256, 18: 21183 (JINR-P-1580)
DUARDO, J. A., Ionization processes in Cs vapor, 18: 20853
DUBINI, Mario, Synthesis of thiophosphoric esters labeled with P-32, 18: 20024
DUBININ, N. P., Comparisons of γ- and x-ray RBE on human cell nuclei, 18: 19685
DUBININA, L. G., Comparisons of γ- and x-ray RBE on human cell nuclei, 18: 19685

DU BRIDGE, R. A., Prog. rpt. on in-core instrumentation, 9–12/63, 18: 21563 (GEAP-4483)
DUBRIN, James, Studies of reactions of atomic C, 18: 20022 (CONF-322-10)
DUBROVINA, Z. V., Strontium-90 content of food products after cooking, 18: 20238 (JPRS-24139)
DUBROVSKII, G. V., Nonadiabatic transitions in slow collisions between heavy particles, 18: 20985
DUBUS, F., Measurement of complex permittivity of plasma, 18: 21458
DUECHS, D., Three fluid model for a partially ionized plasma, 18: 21527
DUEREN, R., Calculations of resonance behavior of scattering cross section for atomic collisions. II., 18: 20765
DUFF, M. J. B., Design of six digitized microscopes, 18: 20295
DUFFY, R. E., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
DUFLO, J., Construction of spark chamber with transparent metal mesh, 18: 20370
DUKE, C. B., Approximation method in collision theory, 18: 21304
DULIS, E. J., High-strength, elevated-temperature, corrosion-resistant steel, 18: 20446 (ASD-TDR-63-766)
DUMMER, Gerald, Superconductivity of the Zr–Rh alloy, 18: 21104
DUNAITSEV, A. F., Beta decay of the pion, 18: 20905 (JINR-P-1559)
DUNCAN, R. S., Electron bombardment heater for Na, 18: 20132 (NAA-SR-Memo-8289)
DUNEGAN, H. L., High-temperature dynamic modulus measurements by ultrasonics, 18: 20196 (UCRL-7326)
DUNFORD, Charles L., Theoretical calculation of (n,p) cross sections, 18: 21165 (CONF-490-1)
DUNLOP, J. D., Spectroscopic investigation of thermionic converter, 18: 20854
DUNLOP, James D., Theoretical model of thermionic converter, 18: 20848
DUQUESNE, Maurice, Energy dissipation of tritium in microorganisms, 18: 19633
DURAND, J. L., Investigation of Hall propulsor characteristics, 18: 21391
DURNEY, Bernard, MGD constant Mach number duct equations, 18: 20839
DURUP, Jean, Production of graft copolymers, 18: 20096
DUSHIN, L. A., Microwave emission in an electrodeless induction discharge, 18: 21394
DUTTON, J., Ionization and attachment coefficients, 18: 21470
DVORAK, K., Optimum distribution of Y-90 seeds in radiation hypophysectomy, 18: 19824
DWYER, O. E., Bilateral heat transfer in annuli, 18: 20186
D'YACHKOVA, R. A., Concentration of Pa-231 from U processing wastes, 18: 20105
DYAKOV, I. G., Critical magnetic fields of superconducting Nb films, 18: 21114
DYBCYNSKI, Rajmund, Separation of rare earths on anion exchange resins. IV., 18: 20110
DYMNIKOV, A. D., Achromatic quadrupole lenses, 18: 20686
DZHELEPOV, B. S., Decay scheme of Tm-164, 18: 21174 (JINR-P-1478(p.3-25))
DZUBAY, T. G., Differential cross sections for reaction $Li^7(Li^7,\alpha)Be^{10}$, 18: 21283

E

EASTMAN, G. Y., In-pile testing of a nuclear-fueled thermionic energy converter, 18: 20881
EASTMAN, G. Y., Thermionic converter operation in multiple connection, 18: 20885
EBERHAGEN, A., Emission from neutral H in θ pinch, 18: 21528
ECKER, G., Inhomogeneous thermal plasma column, 18: 21469
ECKERT, Hans U., Diffusion-controlled electrodeless ring discharges, 18: 21509
EDELS, H., Determination of gas discharge temperatures, 18: 21481
EDELSON, E., Shunting mechanisms in exploding wires, 18: 21536
EDERER, D. L., Photoionization cross section of Ne, 18: 20728 (AD-412421)
EDGE, R. D., Choice of primary proton energy for meson factory, 18: 21213 (TID-20440)
EDMONDSON, B., Determination of the nature of dislocation loops, 18: 20546
EDWARDS, D. R., Numerical solution of the multigroup equation, 18: 21155
EDWARDS, W. E., Gamma production cross sections, 18: 21169 (GEMP-278)
EGAN, J. J., Free energy of formation of ThC_2, 18: 19977
EGGERT, G. L., Influence of neutron irradiation on dimensional stability of steel, 18: 20584 (SC-R-64-120)
EGIDI, A., Intense artificial radioactivity in autumn 1962, 18: 21082
EHRMAN, John Robert, Integration techniques in quantum field theory, 18: 21065
EICHELBERGER, J. F., Prog. rpt., 10/63, 18: 21707 (MLM-1177)
EICHELBERGER, J. F., Prog. rpt., 11/63, 18: 21708 (MLM-1178)
EICHELBERGER, J. F., Prog. rpt., 12/63, 18: 21709 (MLM-1179)
EICHLER, O., Secretion of I-131 in thyroidectomized guinea pigs, 18: 19528
EIDELBERG, Paul, Techniques which aid in quantitative interpretation of scan data, 18: 19835
EIDUS, L. Kh., Nature of "inverse" O effect under effects of radiation, 18: 19692
EISENBUD, Merril, Radioactivity in atmospheric effluents of power plants, 18: 20265
EISENHAUER, C., Milne problem for thermal neutrons and light gases, 18: 21144
EISNER, P. N., Prog. rpt. on radiation effects on EM signals in air, 9/30/63, 18: 20618 (NP-13799)
EITNER, D., Luminescence of ZnS after excitation with ions, 18: 20011
EITZ, A. W., Calculation of effective cross sections for power reactors, 18: 21654
EKSPONG, G., Experimental observations on resonances, 18: 20899 (CERN-64-6(p.71-98))
EL-BADAWI, Ahmed Adel Ismail, Over-tenderization of beef muscle resulting from irradiation, 18: 19758
ELDRIDGE, E. A., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
ELIZAROVA, G. L., Polarographic catalytic H currents and determination of Be, 18: 19908
ELKO, E. E., Palmitate-1-C^{14} metabolism in the rabbit, 18: 19665
ELLIOT, H., Motion of cosmic particles in geomagnetic field, 18: 20822
ELLIOTT, H., Cosmic-ray measurements in U.S./U.K. satellite S-51, 18: 20828
ELLIOTT, J. H., Scattering of 65-Mev He ions from O-16, 18: 21260
ELLIS, W. H., Nuclear properties of Re, 18: 21205 (NP-13807)
ELLISON, Frank O., Nuclear magnetic shielding constants, 18: 21233
ELLSWORTH, L. D., Nuclear energy states of In-115, 18: 21289
ELSTON, J., Investigation of sinterable BeO powders, 18: 20505
ELSTON, J., Properties of BeO before and after irradiation, 18: 20605
ELVING, Philip J., Current-potential relationships at rotating disc electrode, 18: 19936 (TID-20485)
EMMERICH, W. S., MHD: its future potential, 18: 20838
EMRICH, D., Radiation exposure and radiation protection in medicine, 18: 20254
EN, Kuo-kuan, Rotational energy levels of Tb-160, Ta-182, Re-186, and Re-188, 18: 21312
ENDO, T., Stability of natural rubber, 18: 21735 (SC-T-64-610)
ENGLE, Leon B., Fast-neutron fission of Th-232, U-233, U-235, U-238, and Pu-239, 18: 21296
ENGLEFIELD, M. J., Scattering by potentials with an inverse-square attraction, 18: 21055
ENGLISH, J. L., Stress corrosion cracking of austenitic stainless steel in uranyl sulfate solutions, 18: 20477
EPIFANOVA, O. I., Mitosis and interkinesis in mouse tissues, 18: 19609
EPSTEIN, H., Four-point function in momentum space, 18: 21037
EPSTEIN, Harold M., Shielding studies on salt slabs, Gd, and water, 18: 21543 (BMI-1384)
ERIDANI, S., Distribution of Bi-206 in the rat, 18: 19529
ERLER, H., Coaxial-symmetrical flow spark counter, 18: 20348
ERMOLAEV, V. A., Microhardness of crystals of natural zircon, 18: 19953
ERNE, F. C., Energy levels of Ar-36 and Ar-38, 18: 21264
EROZOLIMSKII, G. B., Errors in experiments on coincidence beams, 18: 20382
ERPENBECK, Jerome J., Stability of step shocks, 18: 20624 (LADC-5814)
ERPENBECK, Jerome J., Stability of idealized one-reaction detonations,

18: 20648
ERRERA, M., Effects of x rays on RNA of HeLa cells, 18: 19599
ERSHLER, B. V., Formation of molecular products in H_2O radiolysis, 18: 20050
ERSHOVA, T. I., Corrosion of Mg alloys with rare earths and other elements, 18: 20482
ERWIN, A. R., $\omega-\rho$ interference, 18: 21017
ESCOBAR, Ismael, Variations in cosmic rays and radiosonde measurements, 18: 20814 (AD-434540)
ESKIND, Neil, Low-temperature chamber, 18: 21729 (UCRL-7349)
ESTRIN, M. I., Analysis of cylindrical shell clamped along oblique contour, 18: 21733 (ORNL-tr-19)
ESTULIN, I. V., Circular polarization of γ quanta emitted by atomic nuclei after β decay, 18: 21309
EVANS, D., Easter school for emulsion physicists, St. Cergue, 3/63, 18: 20895 (CERN-64-6)
EVANS, G. W., Characteristics of irradiated pork. I., 18: 19616
EVANS, G. W., Characteristics of irradiated pork. II., 18: 19617
EVANS, John C., Magic 6,000, 18: 19828
EWALD, Heinz, Mass spectrograph for analysis of fission-product beams, 18: 20311
EWALD, Heinz, Mass spectrographic separation of ion beams fission of U-235, 18: 20312
EWAN, G. T., Application of Li-drift Ge γ spectrometers at high energies, 18: 20374
EWART, Alan, Reactions induced in Ni-58 with He ions, 18: 21294

F

FABREGA, S., Instabilities in boiling water loops, 18: 20178 (TID-7694(p.61-70))
FABRY, Thomas L., Conductance of the alkali halides. VIII., 18: 19976
FACKLER, O., Observation of $P^o \rightarrow 2\pi^o$, 18: 20960
FADEEV, V. I., Pulse ionization chamber for measuring angular energy distributions of fission fragments, 18: 20392
FAELTHAMMAR, C.-G., Acceleration of cosmic particles by magnetic pumping, 18: 20823
FAESSLER, Amand, Comparison of Davydov theory with model of rotation-vibration interaction, 18: 21323
FAIRBANK, H. A., Properties of liquid He-3 below 1°K, 18: 20806
FAIRBANK, W. M., Nature of λ transition in liquid He, 18: 20793
FALDUM, B., Spin determination of ground state of Hg-203, 18: 21317
FARADAY, Bruce John, Color centers in KCl and KBr, 18: 20668
FARADI, L., Change of function of suprarenals with acute radiation injury, 18: 19676
FARBER, Milton, Properties of Be compounds. V., 18: 19969
FARNES, M. P., Transplantation potential of hematopoietic tissue, 18: 19527
FAUGERE, Jean-Francois, Improvements in fuel elements, 18: 21625
FAULKNER, Donald N., Metabolism of serum proteins in rat/mouse chimera, 18: 19590
FAUSTOV, R. N., Quasipotential equation for two-particle system, 18: 20908 (JINR-P-1566)
FAUSTOV, R. N., Positronium energy levels, 18: 20909 (JINR-P-1572)
FAVALIER, Jean, Some instabilities in a discharge, 18: 21479
FEATHER, N., Fragment mass distribution for U-235 fission, 18: 21280
FEE, G. G., Krypton-filled thermionic converter, 18: 20831 (APL-TDR-64-28)
FEFILOV, B. V., Spontaneous fission of element 102 isotope with mass number 256, 18: 21183 (JINR-P-1580)
FEICK, G., Thermodynamics of La and Nd hexaborides, 18: 19928 (CONF-405-6)
FEIGL, Fritz, Reagent and method for determining Sb, 18: 19855 (UCRL-Trans-1011(L))
FEINBERG, E. L., Information on strong interactions, 18: 20968
FEINBERG, R., Plasma disturbance, 18: 21461
FELDMAN, C., Variation of Cs in the ocean, 18: 20220
FELDMAN, Michael, Immune response in immunologically suppressed animals, 18: 19722
FELDMAN, Michael, Lymphoid regeneration in irradiated mice, 18: 19546
FELST, R., Reaction $F^{19}(d,n)Ne^{20}$, 18: 21241
FENDLEY, J. R., Jr., Gas analysis and gas dosing of Cs vapor diodes, 18: 20856
FERBEL, T., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
FERNANDES, S. I., Crystal structure of lime-stabilized zirconia, 18: 20020
FERNANDES, S. I., Sub-solidus equilibria in $CaO-ZrO_2$ system, 18: 20578
FERNANDEZ, C., Specific tritium labeling by Wilzbach method, 18: 20073
FERRARI, E., Production of the F^{18} pion-nucleon isobar, 18: 20927
FERREBEE, J. W., Effect of thymus transplantation on radiation chimeras, 18: 19766
FERREBEE, Joseph W., Survival of lethally irradiated dogs, 18: 19603
FERRELL, J. K., Convection boiling inside channels, 18: 20175 (TID-7694(p.42-3))
FESSENDEN, T., Particle orbit studies, 18: 21521
FETZ, H., Mass dependence of sputtering at low bombarding energies, 18: 20786
FICHTE, H., Changes of blood count after telecobalt irradiations, 18: 19749
FICKEL, H., Early uptake measurements and radiation dose in the radio-iodine test, 18: 19822
FIEGEL, Leon J., Crystallographic study of $Nb_2O_5 \cdot 3WO_3$, 18: 19941
FIELD, David L., Quality surveys from vendor's point of view, 18: 21718 (SC-R-64-135)
FILA, G., Radiochemical reactions in the presence of quartz, 18: 20045
FILIPPOV, A. I., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
FILLER, William S., Propagation of shock waves in a hydrodynamic conical shock tube, 18: 20647
FILYUSHKIN, I. V., Spectra of fast neutrons of Po–Be source passing through shield, 18: 21136
FINCH, R. D., Cavitation in liquid He, 18: 20678
FINKEL, A. J., Cancer hazards of exposure to radioactive isotopes, 18: 19597
FINKELSTEIN, Jordan, Stability of tritium label in 1,2-H^3-D-aldosterone, 18: 19543
FINKELSTEIN, R. J., Electromagnetic interactions of a Yang-Mills field, 18: 21062
FINN, A. C., Three-body final-state interactions in special case, 18: 20916 (UCRL-10773)
FINZER, P., Secretion of I-131 in thyroidectomized guinea pigs, 18: 19528
FIRK, F. W. K., Energy spectra of photoneutrons from $O^{16}(\gamma,n)$, $S^{32}(\gamma,n)$, and $Ca^{40}(\gamma,n)$, 18: 21257
FISCHER, E. A., Doppler coefficient for Pu-oxide-fueled fast reactors, 18: 21593 (APDA-157)
FISCHER, G. J., Safety rpt. on ZPR-VI, 18: 21592 (ANL-6271)
FISCHER-COLBRIE, H., Electrodeposition of rare-earth elements, 18: 20495
FISHER, C. R., Prog. rpt. on Rb/Cs evaluation, 2/16–6/30/62, 18: 19925 (AGN-8065)
FISHER, Philip C., Fast-neutron fission of Th-232, U-233, U-235, U-238, and Pu-239, 18: 21296
FITE, Wade L., Negative ions in afterglows, 18: 21093
FLAMM, E. J., Production of C-14 by solar protons, 18: 20817
FLAMM, E. J., Solar neutrons and the earth's radiation belts, 18: 20820
FLAMMERSFELD, A., Determination of L-fluorescence yield of Dy, 18: 21320
FLAMMERSFELD, A., Light yields of organic crystals for α particles and electrons, 18: 20408
FLAVIN, R. K., Prog. rpt. on collision probabilities of electrons and Cs ions in Cs vapors, 1/62–1/63, 18: 21379 (N63-13602)
FLAVIN, Richard K., Collision cross section of electrons with Cs atoms, 18: 20773
FLECK, D. C., Direct electrolysis of UO_2 to U metal, 18: 20448 (BM-RI-6436)
FLEISCHMANN, Rudolf, Gamma radiation from thermal neutron capture in Se-77, 18: 21329
FLEMING, R. J., Critique and extension of Maier-Leibnitz experiment, 18: 21471
FLEMMING, Kurt, Photochemical amine formation, 18: 20081
FLEROV, G. N., Spontaneous fission of element 102 isotope with mass number 256, 18: 21183 (JINR-P-1580)
FLESCH, Gerald D., Isotopic composition of V from organic sources. I., 18: 19519 (IS-655)

FLETCHER, J., Ionization coefficients in H, He, and Ne, 18: 21477
FLIEDNER, T. M., Effects of whole-body irradiation on human marrow, 18: 19602
FLIEDNER, T. M., Fate of H^3-thymidine-labeled bone-marrow cells in irradiated recipients, 18: 19769
FLIEDNER, Theodore D., Autologous bone-marrow transfusion following chemotherapy, 18: 19768
FLUIT, J. M., Sputtering of Cu by ion bombardment, 18: 20784
FODORNE, C. P., Measurement of H-3 with liquid scintillator. I., 18: 19890
FODORNE, C. P., Measurement of tritium with liquid scintillator. II., 18: 19891
FOLSOM, T. R., Variation of Cs in the ocean, 18: 20220
FONTANA, M. G., Prog. rpt. on oxide formation in initial stages of oxidation, 7/60–6/63, 18: 20468 (AROD-2734:2)
FONTANA, Peter R., Dipole-quadrupole and retardation effects in low-energy atom-atom scattering, 18: 20733 (WIS-TCI-41)
FONTS, A. R., Effects of Sr-90 and x radiation on rat teeth, 18: 19655
FOOKES, R. A., Two modes of pulse recording on magnetic tape, 18: 20276 (AAEC/TM-227)
FOREMAN, A. J. E., Elastic energy of Rhombus-shaped dislocation loop, 18: 20547
FOREST, Edward, Dielectric behavior of H_2O and D_2O in dioxane, 18: 19957
FORMAN, R., Krypton-filled thermionic converter, 18: 20831 (APL-TDR-64-28)
FORMAN, Ralph, Irradiated inert gas-filled thermionic diodes, 18: 20861
FORRESTER, Gabriele M., Effect of D_2O on *Pisum sativum* and *Zea mays*, 18: 19662
FORST, G., Scattering of Li^+ ions on rare gases, 18: 21318
FOSTER, M. S., First observation of solution of Li_3Bi, 18: 19978
FOTI, S. C., Determination of oxidation states of U, Np, and Pu, 18: 19896
FOURDEUX, A., Deformation mechanisms in Nb, 18: 20543
FOWLER, A. G., Calculating fast fission effect in coaxial cylindrical lattice cells, 18: 21609
FOWLER, P. H., Nuclear interactions from 30 to 10^6 Bev, 18: 20969
FOWLER, William A., Combined H- and He-burning in red giant star, 18: 20727
FOWLER, William A., Massive stars, 18: 20715
FOX, Marvin, Auxiliary discharge thermionic energy converter, 18: 20858
FRADKIN, E. S., Asymptotic value for interaction cross section for two Fermi particles, 18: 20990
FRADKIN, G. E., Effects of γ radiation on autotrophic mutants of *coliform bacterium*, 18: 19688
FRANCHETTI, S., Theory of the He film, 18: 20795
FRANCIS, Norman C., Theoretical calculation of (n,p) cross sections, 18: 21165 (CONF-490-1)
FRANKE, H., Decay rates of H^- ions in isochronous cyclotron, 18: 20698
FRANK-KAMENETSKII, A. D., Application of Monte Carlo method of multi-group reactor calculations, 18: 21601
FRANKLIN, R. N., Number density distributions at low pressures, 18: 21465
FRANKS, Larry A., Effects of heating and γ radiation on Pb flint glass, 18: 20586
FREAS, David, Irradiation effects on solid lubricant materials, 18: 20585 (WANL-TNR-109)
FREDERKING, T. H. K., Stability of film boiling two-phase flow in cryogenic systems, 18: 21119
FREE, B. A., Prog. rpt. on effect of impurities of Cs fuel upon ion engines, 12/63–2/64, 18: 20626 (NP-13800)
FREEDMAN, Daniel Z., Model for the nucleon and baryon Regge trajectories, 18: 20940
FREEMAN, R., Analyzing γ spectra using a computer, 18: 21248
FREIER, P. S., Modulation of heavy nuclei in primary cosmic radiation, 18: 20813 (AD-434176)
FREILING, E. C., Determination of oxidation states of U, Np, and Pu, 18: 19896
FREISER, Henry, Extraction, 18: 20103
FRETTER, W. B., Interactions of 17-Bev/c negative pions, 18: 20891 (AD-433625)
FRICKE, G., Production of Be-7 by photoeffect on Be, B, and C, 18: 21328
FRIDMAN, A. M., Critical magnetic field and anomalous diffusion in plasma, 18: 21398
FRIDRICH, R., Influence of a new antiphlogistic on reaction to radiation, 18: 19803
FRIED, Ilona, Current-potential relationships at rotating disc electrode, 18: 19936 (TID-20485)
FRIEDBERG, Mary H., Metabolism of serum proteins in rat/mouse chimera, 18: 19590
FRIEDBERG, Wallace, Metabolism of serum proteins in rat/mouse chimera, 18: 19590
FRIEDMAN, Herman, Specific restoration of agglutinin formation in x-irradiated rabbits, 18: 19765
FRIEMAN, E. A., Kinetic theory of weakly coupled gases, 18: 21376 (MATT-238)
FRIICHTENICHT, J. F., Micrometeoroid simulation using nuclear accelerator techniques, 18: 20707
FRISBY, H., Properties of BeO before and after irradiation, 18: 20605
FRISCH, D., Observation of $f^0 \rightarrow 2\pi^0$, 18: 20960
FRISCH, H. L., Quantum isotope effect in permeation, 18: 19961
FRISCHKORN, Rolf, Walker carcinomas after single irradiation with Co-60, 18: 19699
FRITZ, James S., Separation of rare earths, 18: 20104
FRITZ, James S., Spectrophotometric determination of perchlorate, 18: 19843 (IS-658)
FROLOV, A. S., Calculation of continuous integrals by Monte Carlo method, 18: 21737 (UCRL-Trans-1040(L))
FROLOVA, V. S., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
FRYE, Alfred H., Chemistry of poly(vinyl chloride) stabilization. III., 18: 20028
FRYE, Alfred H., Chemistry of poly(vinyl chloride) stabilization. IV., 18: 20029
FRYE, Alfred H., Chemistry of poly(vinyl chloride) stabilization. V., 18: 20030
FRYE, Glenn M., Jr., Neutrons from interaction of 14-Mev neutrons with Li-6 and Li-7, 18: 21263
FUJII, Isao, Determination of O in metals by 14-Mev neutron activation, 18: 19886
FUJITA, F. E., Isochronal differential microcalorimeter, 18: 20309
FUJITA, Minoru, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
FUKUDA, Hiroshi, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
FUKUMITSU, Yoshio, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
FUKUSHIMA, Nooshi, Local geomagnetic disturbance in high latitudes, 18: 21079
FULBRIGHT, H. W., Reaction (He^3,n) on C-12 and C-13, 18: 21259
FULLER, D. D., Prog. rpt. on application of gas-lubricated bearings, 9–11/63, 18: 20135 (TID-20448)
FULLWOOD, R ., Energy-dependent extrapolation length in polyethylene, 18: 21132 (RPI-328-4)
FULMER, R. H., Spin dependence of (d,t) $l_n = 1$ angular distributions in Ni and Fe, 18: 21301
FULRATH, Richard M., Liquid-solid transformation kinetics in Al_2O_3, 18: 20534 (UCRL-11166)
FUMELLI, M., Fluctuations and rotations in a plasma column, 18: 21504
FUOSS, Raymond M., Conductance of the alkali halides. VIII., 18: 19976
FURNISH, A. P., Prestressed concrete spherical containment vessel, 18: 20130 (LADC-5817)
FURTH, Harold P., Closed magnetic vacuum configurations, 18: 21414
FURUKANE, Utaro, Collision damping of plasma wave, 18: 21404

G

GABLA, Lubomir, Spectral isotopic analysis of Pb from Polish galena deposits, 18: 20430
GABLER, Eduard, Tuberculosis and whole-body x irradiation of guinea pigs, 18: 19715
GAEBLER, O. H., Studies of body water and water turnover, 18: 19530
GAERTTNER, E., Energy-dependent extrapolation length in polyethylene, 18: 21132 (RPI-328-4)

GAEUMANN, T., Radiation chemistry of hydrocarbons. X., 18: 20055
GAEUMANN, Tino, Radiation chemistry of hydrocarbons. XI., 18: 20053
GAEUMANN, Tino, Radiation chemistry of hydrocarbons. XII., 18: 20054
GAILLOUD, M., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
GAINES, G. B., Thermionic emission behavior of W, 18: 20875
GAISCH, H., Preservation of food and sterilization of pharmaceutical products. A., 18: 19658
GALE, A. John, Accelerator design concepts. I., 18: 20708
GALITSKII, V. M., Effect of quantum absorption on bremsstrahlung of ultrarelativistic electrons, 18: 21334
GALL, D. A., Flow-balancing device for BWR, 18: 21573 (NYO-10475)
GALLI, A., Charge-exchange between rare-gas ions and molecules, 18: 20742
GALLINA, F., Effect of propylthiouracil in the totally irradiated animal, 18: 19780
GALLINA, F., Recovery in totally irradiated animals, 18: 19779
GALZENATI, E., Spectral representation in potential scattering, 18: 21035
GAMMEL, Juanita, Neutrons from interaction of 14-Mev neutrons with Li-6 and Li-7, 18: 21263
GANIS, Frank M., Amino-acid excretion in accidentally irradiated humans, 18: 19638
GARDINER, Donald A., Response contours of hot-pressed density of ThO_2 pellets, 18: 20524 (ORNL-3608)
GARDNER, C. S., Stability of plane MHD shocks, 18: 20649
GARDNER, J. W., Photon-drag in solids and plasmas, 18: 21407
GARDNER, Ross D., Determination of Mo in U–Mo alloys with α-benzoinoxime, 18: 19846 (LA-3058)
GARELIS, Edward, On the ($K\beta/I$) pulsing theory, 18: 21607
GARIBYAN, J. H., Effect of toxins on O consumption by irradiated rats, 18: 19742
GARLICK, G. F. J., Luminescence of meteorites, 18: 20072
GARLOCK, Edward, Cell for determining extractables in irradiated materials, 18: 19889
GARN, Stanley M., Gonadal dosages in investigative radiography, 18: 20264
GARVIN, Hugh L., Series operation of thermionic diodes, 18: 20883
GASPARI, G. D., Theory of core-electron contributions to hyperfine interactions, 18: 20749
GASPARI, G. P., Pressure drops in steam–water mixtures, 18: 20164 (EURAEC-1004)
GATTI, P., Gyromagnetic ratio of the 4^+ state of Ce-140, 18: 21286
GATTO, R., Tests for spin and parity of the B meson, 18: 20957
GEFFERTH, K., X-ray hazard and protection in infants and children, 18: 20263
GEHMAN, B. L., Power output of thermionic cells, 18: 20871
GEIGER, J., Scattering of 25-kev electrons on gases. II., 18: 20764
GEISSLER, Georg, Effects of x radiation on alkali nitrate solutions, 18: 20080
GEISTER, D., Three-phase a-c arc heater, 18: 20129 (ARL-64-29)
GELDART, Derek, Improvements in production of Be, 18: 20466
GEL'FAND, I. M., Calculation of continuous integrals by Monte Carlo method, 18: 21737 (UCRL-Trans-1040(L))
GELL-MANN, M., Vacuum trajectory in conventional field theory, 18: 21063
GELMONT, B. L., Hydrothermomagnetic waves in weakly inhomogeneous plasma, 18: 21422
GENDRIN, R. E., Mechanisms of vlf emission, 18: 21088
GENNA, Sebastian, Corrections for two-crystal whole-body counter, 18: 20337 (NYO-2553-1)
GENSICKE, Friedrich, Metabolism of Pr-143 after inhalation of liquid aerosol, 18: 19544
GENTRY, W. O., Prog. rpt. on Nb alloy sheet rolling, 7/7/63–9/6/63, 18: 20484 (AD-418992)
GEORGE, G. G., Radiation damage effects in Si surface-barrier counters, 18: 20357
GERARDO, James Bernard, Electrically driven shock waves in gases, 18: 21448
GERBER, G. B., Studies on detoxication by perfused liver. I., 18: 19631
GERBER, G. B., Studies on detoxication by perfused liver. II., 18: 19632
GERHART, J. B., Proton spin flip and substate excitation in inelastic scattering, 18: 21252
GERMAIN, C., Discharge mechanism in vacuum, 18: 20140
GERSHUNI, G. Z., Sphere rotation in viscous conducting fluid in magnetic field, 18: 20664
GERTSRIKEN, S. D., Solid-state diffusion in metals and alloys, 18: 20536 (AEC-tr-6313)
GESHKENBEIN, B. V., Restrictions on $e^+ + e^- \to \pi^+ + \pi^-$ reaction cross section by analyticity condition, 18: 20986
GETOFF, N., Electrodeposition of Th and U, 18: 20494
GETOFF, N., Electrodeposition of rare-earth elements, 18: 20495
GEY, Wolfgang, Superconductivity of the Zr–Rh alloy, 18: 21104
GEY, Wolfgang, Superconduction of Ga at high pressures, 18: 21108
GEZALYAN, L. S., Radiation effects on compensatory processes in neural system injury, 18: 19729
GHYS, Roger, Serum proteins in rats after protracted irradiation, 18: 19642
GIARDINI-GUIDONI, A., Charge-exchange between rare-gas ions and molecules, 18: 20742
GIBEAUT, W. A., Properties of coated refractory metals, 18: 20452 (DMIC-195)
GIBSON, A., Impurity concentrations and electron temperatures in C-stellarator, 18: 21378 (MATT-251)
GIBSON, A., Power balance measurements in C-Stellarator with divertor, 18: 21377 (MATT-247)
GIBSON, A. S., Leakage through cracks and capillaries in concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)
GIBSON, R., Transport regulations, 18: 20248
GIFFORD, Fay E., Development of Ba–U emitter materials, 18: 20877
GILBERT, L. M., Aerothermochemical behavior of graphite, 18: 20525 (R63SD89)
GIL'DENBURG, V. B., Plasma resonances in heterogeneous objects, 18: 21440
GILLESPIE, Arthur S., Jr., Radio-release technique for measurement of gas moisture, 18: 19848 (ORO-591)
GILLIGAN, J. E., Radiation effects on spacecraft thermal control materials, 18: 20603
GILLOIS, M., Preparation of thin C films, 18: 20451 (CEA-2390)
GILMORE, J. T., Computer routines for activation analysis, 18: 19918
GILMOUR, George Arthur, Radiation-induced signals in semiconductor devices, 18: 20413
GINZBURG, S. L., Analytical properties of Green function and mass operator, 18: 20987
GIOVANNOZZI-SERMANNI, G., Succinic thiokinase and succinic dehydrogenase of *Rhodotorula gracilis* as influenced by tritiated water and cystamine, 18: 19786
GIRARD, B., Computation of 6th order compensated solenoids, 18: 20298
GIRARD, J. P., Longitudinal injection of charged particles into static magnetic configuration with mirrors, 18: 21370 (CEA-R-2410)
GIULIANI, P., Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
GIVENS, Wyatt Wendell, Gamma radiations from N-16, O-19, and Ne-19, 18: 21352
GJOETTERUD, K., Possible origin of spin-orbit coupling in nuclei, 18: 21192 (KR-64(Sect.IX))
GJOETTERUD, K., Shell theory, 18: 21188 (KR-64(Sect.V))
GLASER, Arnold, Resistivity measurements, Hardhat event of Project Nougat, 18: 20200 (ARA-1054)
GLASER, V., Four-point function in momentum space, 18: 21037
GLASHOW, S. L., Theory of strong interaction symmetry breakdown, 18: 20941
GLASNER, A., Analysis of $Eu(C_2O_4)_3$ and Eu(II) salts, 18: 19897
GLASSMAN, Arthur J., Brayton-cycle space-power-generation systems, 18: 21679
GLAVIN, G. G., Determination of O in rare earth metals oxides and metal fluorides, 18: 19907
GLAZOV, A. A., Ion source for 1-Mev photon accelerator, 18: 20691
GLAZUNOV, M. P., Determination of individual radioisotopes in mixture with β radiation, 18: 19911
GLICK, H. S., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
GLOBERSON, Amiela, Immune response in immunologically suppressed animals, 18: 19722
GLOBERSON, Amiela, Lymphoid regeneration in irradiated mice, 18: 19546
GLOECKLE, W., Low excitation degree of Na-23 according to collective model, 18: 21327

GLOS, Margaret Beach, Semiconductors, scintillators, and data analysis, 18: 20375
GLOVER, Everett D., Fission damage in calcite, 18: 20224
GLOVER, Rolfe E., Effect of electron mfp on upper critical magnetic field of superconducting Sn, 18: 21109
GODLFINGER, P., Vaporization of sulfides of Ca, Sr, and Ba, 18: 19939 (WADD-TR-60-782(Pt.XXI))
GOLDBERGER, M. L., Vacuum trajectory in conventional field theory, 18: 21063
GOLDBERGER, Marvin L., Time correlations for quantum-mechanical systems, 18: 21051
GOLDEN, Robert L., Absolute decay rate for $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, 18: 20956
GOLDENBAUM, George, Pressurized trigatrons, 18: 20147
GOLDHABER, Alfred S., Tests of the one-pion-exchange model, 18: 20935
GOLDIN, L. L., Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
GOLDMAN, A., Mechanism of initial control of spark gap, 18: 20151
GOLDMAN, A., Study of prebreakdown discharge, 18: 20145
GOLDMAN, Alice, Formation of an electric arc in vacuum, 18: 20142
GOLDMAN, M., Formation of disruptive discharge in gas, 18: 21494
GOLDMAN, M., Mechanism of initial control of spark gap, 18: 20151
GOLDMAN, Max, Formation of an electric arc in vacuum, 18: 20142
GOLDRING, G., Mass of Ni-56, 18: 21357
GOLDSTEIN, C. M., Current-voltage curve in Cs diode, 18: 20843
GOLDZAHL, L., Construction of spark chamber with transparent metal mesh, 18: 20370
GOLER, S. V., Penning-discharge with heated cathode, 18: 20154
GOLLAND, J. D., Application of analytical methods to refractory metals, 18: 19921
GOLLIHER, W. R., Plasma torch production of elemental boron, 18: 18832 (KY-453)
GOLOVANIVSKII, K. S., Compression of plasma column, 18: 21518
GOLOVANIVSKII, K. S., Quasi-potential in low-temperature plasma, 18: 21519
GOLUTVIN, I. A., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
GOODALL, D. H. J., Formative time lags in a pressurized spark gap, 18: 21493
GOODMAN, J. W., Transplantation of peritoneal cells, 18: 19591
GOODMAN, Joan Wright, Effect of thymus transplantation on radiation chimeras, 18: 19766
GOPINATHAN, K. P., Decay of Cd-117, 18: 21288
GORBANYUK, A. G., Motion of dense plasma clusters in toroidal solenoid magnetic field, 18: 21437
GORDUS, Adon A., Energetic recoil atom reaction mechanisms, 18: 20041 (MMPP-167-6)
GORDY, Walter, Millimeter-wave molecular-beam spectroscopy, 18: 19990
GORICHEV, P. A., Formation of multiple fragments at proton energy of 660 Mev, 18: 21230
GORMEZANO, C., Experimental study of an r-f Ar torch, 18: 21517
GOROKHOV, L. N., Reaction of $AlCl_3$ with $BeCl_2$, 18: 19950
GOSSLEE, D. G., Late somatic effects of x radiation in mice, 18: 19796
GOTTLIEB, Frederick Jay, Genetic control of pattern determination in Drosophila, 18: 19618
GOUDSMIT, S. A., Order of electron shells in ionized atoms, 18: 20758
GOULDING, Fred S., Lithium drifting apparatus for Si and Ge detectors, 18: 20344 (UCRL-11261)
GOULDING, Fred S., Semiconductor detectors, 18: 20376
GOUPIL, J., Gamma spectrography in a rocket, 18: 20411
GOURDINE, M. C., Investigation of Hall propulsor characteristics, 18: 21391
GOURDON, C., Longitudinal injection of charged particles into static magnetic configuration with mirrors, 18: 21370 (CEA-R-2410)
GOZNA, C. F., Breakdown in crossed fields at low pressure, 18: 20153
GRABIGER, Rudolf, Osteoradionecrosis of femoral neck after telecobalt therapy, 18: 19713
GRABIGER, Rudolf, Radiation injuries to hand from operational accident, 18: 19706
GRABOWSKI, Z., Distribution of charged particles in aurorae, 18: 20364
GRAEFF, G., Measurements of hfs, Stark effect, and Zeeman effect of $K^{39}F^{19}$, 18: 20762
GRAEVSKII, E. Ya., Mechanism of cystamine radiation protection, 18: 19800
GRAF, K. A., Microwave measurements of finite plasmas, 18: 21368 (AFCRL-63-161)
GRAHAM, T. C., Survival of lethally irradiated dogs, 18: 19603
GRAHAM, W. R., Cross-section fluctuations in $Al^{27}(p,\alpha)Mg^{24}$ reaction, 18: 21237
GRATTON, R., Breakdown in a theta-pinch apparatus, 18: 21525
GRAUMAN, J., τ^+ analysis, 18: 21018
GRAVES, H. W., Jr., Chemical shim control for reactors, 18: 21652
GRAY, Donald D., Exposure control in cineradiography, 18: 19829
GRECHISHKIN, V. S., Apparatus for observing NQR, 18: 19994
GREEN, J. M., Interdependent electrons in screening constant model of many-electron-atom, 18: 20731 (RM-3803-AEC)
GREENBAUM, Michael A., Properties of Be compounds. V., 18: 19969
GREENBERG, E., Total-body scanning, 18: 19818
GREENBERG, J. M., Optical astronomy above the earth's atmosphere, 18: 21089
GREENBERG, J. M., Polarization of starlight in interstellar medium, 18: 20725
GREENBERG, Joseph, Locus for radiation resistance in *E. coli*, 18: 19619
GREENBERG, L. H., Gamma–α reactions in light nuclei of emulsions, 18: 21224
GREENBORG, J., Two cross section libraries for MAC shielding code, 18: 21545 (HW-73381(Suppl.1))
GREENE, D., Fast neutron source for radiotherapy, 18: 19821
GREENE, Richard G., Separation of rare earths, 18: 20104
GREENFIELD, I. G., Neutron-produced prismatic dislocations in Cu, 18: 20599
GREENFIELD, Leonard J., Prog. rpt. on uptake of radionuclides by microorganisms, 4/15–12/14/63, 18: 19520 (TID-20499)
GREGOIRE, M., Instabilities in a reflex discharge, 18: 21503
GREGORY, B., Curvature and angle measurements in bubble chamber, 18: 20329 (BNL-7933)
GREGORY, B. P., Recent experiments with bubble-chambers at CERN, 18: 20400
GREINER, Walter, Comparison of Davydov theory with model of rotation-vibration interaction, 18: 21323
GREINER, Walter, Giant resonances in heavy nuclei, 18: 21206 (NP-13813)
GRESHAM, Richard B., Collection, storage, and transfusion of peripheral blood leukocytes, 18: 19776
GRIESS, J. C., Stress corrosion cracking of austenitic stainless steel in uranyl sulfate solutions, 18: 20477
GRIFFEL, Maurice, Thermal decomposition of irradiated Ni oxalate, 18: 20061
GRIFFIN, B. I., Radioactivity in northern Alaskan Eskimos and their foods, 18: 20231 (HW-SA-3048)
GRIFFIN, James J., Beta decays and delayed gammas from fission fragments, 18: 21297
GRIGOR'EV, E. P., Decay of Ho-155, 18: 21175 (JINR-P-1479(p.26-34))
GRIGOR'EV, E. P., Decay of Dy-155, 18: 21176 (JINR-P-1479(p.35-9))
GRISHAEV, I. A., Photoneutron yields from targets of great thickness, 18: 21308
GRISHIN, V. K., Longitudinal stability of charged beam in cyclic cyclotrons, 18: 20702
GRIVET, Pierre, Conference on quantum electronics, Paris, 2/63. I and II., 18: 20316
GROCE, I. J., Oxidative decladding of UO_2 fuels, 18: 20111
GRODZINS, L., Gyromagnetic ratio of the 4^+ state of Ce-140, 18: 21286
GROH, H. J., Ion exchange absorption of Cs, 18: 20097 (CONF-179-1)
GROHMANN, K., Phase shift of electron waves, 18: 20318
GROMOV, K. Ya., Decay scheme of Tm-164, 18: 21174 (JINR-P-1479 (p.3-25))
GROMOV, K. Ya., Decay of Dy-155, 18: 21176 (JINR-P-1479(p.35-9))
GROMOV, K. Ya., Decay of Ho-155, 18: 21175 (JINR-P-1479(p.26-34))
GRONSKAYA, N. F., Radiation damage and repair of tissues of *Rana temporaria* tadpoles, 18: 19781
GROSMANN, M., Radiation effects on Cu_2O absorption spectra, 18: 20077
GROSS, Bernhard, Gamma induced currents in Teflon, 18: 20592
GROSS, Leonard, Norm invariance of mass-zero equations, 18: 21032
GROSSE, A. V., Centrifugal plasma jet furnace, 18: 20157

GROSSMAN, L. M., Compatibility of nuclear fuel and thermionic emitter materials, 18: 20876
GROVE, G. R., Prog. rpt., 10/63, 18: 21707 (MLM-1177)
GROVE, G. R., Prog. rpt., 11/63, 18: 21708 (MLM-1178)
GROVE, G. R., Prog. rpt., 12/63, 18: 21709 (MLM-1179)
GRUBER, S., Instabilities in a reflex discharge, 18: 21503
GRUEN, D. M., First observation of solution of Li_3Bi, 18: 19978
GRUNEWALD, Ralph, Analysis of organically bound I, 18: 19877
GRUSHINA, N. V., Mitosis and interkinesis in mouse tissues, 18: 19609
GRZYBOWSKA, D., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
GRZYBOWSKA, D., Radioactivity of water in Poland, 1962, 18: 20211 (CLOR-24)
GUAN, Hong, Intermediate boson theory of weak interaction, 18: 20973
GUEBELI, O., Adsorption of Rn on activated charcoal and silica gel, 18: 19940 (SC-T-64-613)
GUENAULT, A. M., Thermoelectricity in the intermediate state, 18: 21099
GUENTHER, C., Investigation of hfs interaction in $Hf(NH_4)_3F_7$ crystals, 18: 21321
GUILE, A. E., Magnetic deflection of high-current arcs in air, 18: 21487
GUILE, A. E., Motion of cold-cathode arcs, 18: 20144
GULDNER, P., Effect of ionizing radiation on riboflavine, 18: 20090
GUNENKOVA, O. V., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
GUNN, W. F., Field emission from semiconductors, 18: 20152
GUNNERSEN, E. M., Radiation damage effects in Si surface-barrier counters, 18: 20357
GUNTER, E. J., Jr., Prog. rpt. on application of gas-lubricated bearings, 9–11/63, 18: 20135 (TID-20448)
GUNYE, M. R., Axial asymmetry in some nuclei, 18: 21225
GUON, J., Oxidative decladding of UO_2 fuels, 18: 20111
GUREVICH, I. I., Neutral K mesons, 18: 20974
GUREVICH, L. E., Hydrothermomagnetic waves in weakly inhomogeneous plasma, 18: 21422
GURFINKEL, Y., Absolute calibration of neutron sources, 18: 21124 (IA-800)
GUSEV, V. M., Electromagnetic separation of Os isotopes, 18: 20432
GUSTAFSON, D. R., Positron annihilation in rare-earth metals, 18: 20552
GUTKIN, T. I., Plasma equilibrium in space-periodic magnetic field, 18: 21434
GUTMAN, V. I., Effects of foreign ions on electric conductivity of irradiated alkali halide crystals, 18: 20588
GUTOWSKY, H. S., Calculation of chemical shifts. II., 18: 19960
GUTTMAN, Paul H., Glomerulosclerosis in the Chinese hamster after x irradiation, 18: 19672
GUTYRYA, V. S., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
GUTZAIT, L., Survival of skin homografts in mice with bacterial infection, 18: 19511
GUYON, J., Nanosecond pulse generator, 18: 20300
GWATKIN, R. B. L., Effect of x rays on embryonic chick tibiotarsus, 18: 19657
GYFTOPOULOS, Elias P., Volume ionization processes in Cs converters, 18: 20850

H

HAAG, F. G., Nuclear reactor startup, 18: 21559
HAAG, James N., Measurement of plane polarization of γ radiation, 18: 21274
HABERMAN, H. D., Waste management program, 18: 21691 (HW-77163)
HACK, M., Surface of the sun, 18: 20721
HADDAD, E., Delayed γ rays from photofission of U-238, U-235, and Th-232, 18: 21298
HAEGI, Marcel, Transformation of powder into plasma by photolysis, 18: 21524
HAELLER, I. B., Spin-parity of 53-min Cs-135m, 18: 21265
HAFELE, J. C., Capture reaction $K^{39}(p,\gamma)Ca^{40}$ in giant resonance region, 18: 21363
HAGEDORN, R., High-energy scattering and Regge poles, 18: 20896 (CERN-64-6(p.1-30))
HAGER, R., Mossbauer effect in Tm-169, 18: 21290
HAGNER, R., Superconduction in mixed systems with Nb_3Sn, 18: 21110
HAGSTROEM, Stig, Atomic level energies in Hf, 18: 20766
HAGSTROEM, Stig, Electron binding energies in Th, 18: 20767
HAGSTRUM, H. D., Auger-type interaction of ions with solid surfaces, 18: 20780
HAHN, Yukap, Improved minimum principle for multichannel scattering, 18: 21050
HAINES, Geoffrey Herbert, Core supporting arrangements for reactor, 18: 21590
HAJDUKOVIC, Srdjan, Effect of postirradiation bleeding on hematopoiesis and survival. IX., 18: 19717
HAJNAL-PAPP, Maria, Effect of radiation on cardiac activity, 18: 19564
HAJNER, R. C., Prog. rpt. on high-pressure pump seal, 3–5/63, 18: 20133 (NYO-9802)
HALEY, James T., Neutron and α counters for heavy-element column chemistry, 18: 20101 (UCRL-11300)
HALL, E. H., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
HALL, E. H., Thermodynamic and transport properties of K, 18: 20018
HALL, G. R., Electrolytic dissolution of nuclear fuel elements, 18: 20115
HALL, H. E., Equations of motion for rotating He-II, 18: 20796
HALL, I., Cross-section fluctuations in $Al^{26}(p,\alpha)Mg^{24}$ reaction, 18: 21237
HALL, R. B., Energy gain of charged particles after reflection, 18: 21520
HALL, R. F., Inert-gas glow discharge, 18: 21452
HALL, S. H., Rubidium self-oscillating magnetometer for earth's field measurements, 18: 20294
HALL, T. P. P., Vacancy production by x rays in KI, 18: 20656
HALL, W. B., Cesium compatibility of thermionic converter structural materials, 18: 20873
HALL, W. B., Prog. rpt. on thermionic energy converters, annual, 12/15/62–12/15/63, 18: 20829 (AD-429503)
HALLETT, W. J., Practical aspects of Na system reliability, 18: 20194
HALLETT, W. J., Recent progress in Na technology, 18: 20464
HAMAGUCHI, Hiroshi, Anion-exchange behavior of Sc in chloride-thiocyanate media, 18: 20113
HAMILL, William H., Techniques for ion-molecule reactions studies in mass spectrometer, 18: 21703 (CONF-296-4)
HAMILTON, L. D., Hiroshima and Nagasaki data and radiation carcinogenesis, 18: 19581
HAMMEL, E. F., Liquid He-II heat conductivity and fountain pressure, 18: 20798
HAMMILL, William H., Hydrogen formation in the cyclohexane radiolysis, 18: 20057
HAMMITT, Frederick G., Void fraction in cavitating Hg, 18: 20167 (NP-13812)
HANCOX, R., Formative time lags in a pressurized spark gap, 18: 21493
HANDLER, George S., Radial correlation in He, 18: 20739
HANDY, P., Three-phase a-c arc heater, 18: 20129 (ARL-64-29)
HANNA, G. L., Fission-product damage in BeO dispersion fuels, 18: 20615
HANSEN, C. H., Jr., Acute radiation injury and syndrome, 18: 19588
HANSEN, K. F., Numerical solution of the multigroup equation, 18: 21155
HANSEN, L. K., Unignited mode of thermionic diodes, 18: 20846
HANSEN, W. L., Lithium drifting apparatus for Si and Ge detectors, 18: 20344 (UCRL-11261)
HANSON, L. A., Oxidative decladding of UO_2 fuels, 18: 20111
HANSON, W. C., Radioactivity in northern Alaskan eskimos and their foods, 18: 20231 (HW-SA-3048)
HARA, Yasuo, Unitary triplets and the eightfold way, 18: 21045
HARBAUGH, W. E., In-pile testing of a nuclear-fueled thermionic energy converter, 18: 20881
HARBAUGH, W. E., Thermionic converter operation in multiple connection, 18: 20885
HARING, A., Inversion temperature separation of isobaric CO molecules by thermal diffusion, 18: 20435
HARING, Lewis L., Recent advances in low temperature thermionics, 18: 20859
HARLLEE, Fredric H., Mass spectrometry, 18: 19861
HARMER, D. E., Making chemicals via radiation, 18: 20048
HARMON, D. F., Regulatory control program for U milling, 18: 20272
HARMS, Ingrid, Observations of skin reactions in telecesium therapy, 18: 19716
HAROLDSEN, G. O., Hermetic sealing problems in small BWR, 18: 21672 (NAA-SR-Memo-9507)

HARPER, Paul V., Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)
HARPSTER, Joseph W., Decay of 5.4-d Pm-148, 18: 21262
HARRINGTON, L. C., Thermal expansion of TiC cermets, 18: 20513 (CNLM-4234)
HARRINGTON, L. C., Thermal expansion of WC cermets, 18: 20514 (CNLM-4479)
HARRIS, F. M., Ionization and attachment coefficients, 18: 21470
HARRIS, R. L., Plasma torch production of elemental boron, 18: 19932 (KY-453)
HARRIS, R. L., Jr., Uranium-mine ventilation, 18: 20269
HARRISON, E. R., Solar corpuscular radiation and earth's immediate interplanetary environment, 18: 20722
HARRISON, J. A., Absorption of photons from gas discharge, 18: 21474
HARRISON, James, Improvements in fluid coupling devices, 18: 21587
HARRISON, John David Lawrence, Improvements in or relating to reactor fuels, 18: 20507
HARRISON, R. W., Determination of effects of low pressure oxidation, 18: 20480
HARTCORN, L. A., Quantitative metallography of hydride phase in Zy-2 process tubes, 18: 20518 (HW-74949)
HARTECK, P., Gamma radiolysis of CO in presence of rare gases, 18: 20087
HARTER, F., Emitter work function in arc-mode thermionic converters, 18: 20867
HARTLAND, S., Electrolytic dissolution in a potential gradient, 18: 20000
HARTLE, James B., Complex angular momentum in three-particle potential scattering, 18: 21041
HARTLE, James S., Watson-Sommerfeld transformation for many-particle scattering amplitudes, 18: 21040
HARTMANN, G., Study of prebreakdown discharge, 18: 20145
HARTT, Kenneth Leroy, Ground-state properties of Ca-40, 18: 21346
HARVEY, B. G., Scattering of 65-Mev He ions from O-16, 18: 21260
HASHITANI, Hiroshi, Analysis of U-base alloys, 18: 19845 (JAERI-1053)
HASKIN, Larry, Rare-earth distribution patterns in eight terrestrial materials, 18: 20202
HASLAM, R. N. H., Gamma–α reactions in light nuclei of emulsions, 18: 21224
HASSID, A., Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)
HASTED, J. B., Study of ion-atom interchange, 18: 20021
HASTERLIK, R. J., Cancer hazards of exposure to radioactive isotopes, 18: 19597
HATTA, Yoshisuke, Impedance characteristics of positive column, 18: 21457
HAUGHT, A. F., Gas breakdown at optical frequencies, 18: 21513
HAUSMAN, Hershel J., Elastic scattering of He-3 at 20 Mev , 18: 21359
HAWKINS, David, On chance and choice, 18: 19512
HAWKINS, K. G., Grayloc connection for Arco ATR gas loop, 18: 21681 (HW-80680)
HAYAKAWA, Shigeru, Radiation effects on electronic components. I., 18: 20590
HAYASHI, Makoto, Formation stage of spark breakdown, 18: 20146
HAYBITTLE, J. L., 24-Curie Sr-90 unit for whole-body irradiation, 18: 19819
HAYES, M. R., Determination of traces of U, 18: 19900
HAYES, Robert G., Effect of Cl^- and SO_4^{-2} on paramagnetic resonance line width of Mn^{+2}, 18: 21730 (UCRL-10446)
HAZAN, I., Separation of U from Th and rare earths, 18: 20114
HEALD, M. A., Tracing oblique rays in plasma cylinders, 18: 21372 (CLM-R-34)
HEARN, Charles Lee, Electrical properties of radioactive CdS films, 18: 20674
HEARNE, K. R., Determination of gas discharge temperature, 18: 21481
HEDGER, Harry John, Improvements in or relating to nuclear fuels, 18: 20465
HEER, C. V., Resonant frequencies of EM cavity, 18: 20652
HEERSCHAP, M., Interlamellar compounds of graphite with Br, ICl, and $FeCl_3$, 18: 19931 (EUR-542.e)
HEIFETZ, Yu. B., Changes of blood cells and hemopoietic system due to x irradiation, 18: 19730
HEIFETZ, Yu. B., Changes in blood and hemopoietic system shortly after castration due to x irradiation, 18: 19731
HEIFETZ, Yu. B., Phagocytosis of glycogen content in blood cells and hemopoietic organs of irradiated animals, 18: 19734
HEIL, Jane M., Strontium into precipitates of Ca fluoride and phosphate, 18: 19949
HEILIG, K., Isotopic shift in Zr-I spectra, 18: 20002
HEILIGMAN, F., Characteristics of irradiated pork. I., 18: 19616
HEILIGMAN, F., Characteristics of irradiated pork. II., 18: 19617
HEIMANN, G., Production of nuclear emulsions, 18: 20414
HEINE, V., New method for electronic structure of metals, 18: 20548
HEINZINGER, Karl, Isotopic fractionation of H, 18: 19968
HEK, Ku Tse, Decay scheme of Tm-164, 18: 21174 (JINR-P-1479 (p.3-25))
HELFRICH, F., Roller bearings for extreme reactor conditions, 18: 21575
HELLENS, Robert L., Reactor physics data for enriched-U, water-moderated lattices, 18: 21594 (BNL-6975)
HEMPELMANN, Louis H., Radiation-induced thyroid carcinoma, 18: 19598
HEMPHILL, R., Growth in irradiated BeO single crystals, 18: 20609
HEMSTREET, H. W., Jr., Film collectors for thermionic converters, 18: 20870
HENDEE, William R., Effects of x irradiation on fine structure of HeLa cells, 18: 19723
HENDERSON, Douglas, Quantum cell model for hard spheres, 18: 21053
HENDERSON, William B., Cross sections for reactor analysis, 18: 21551 (GEMP-283)
HENKEL, R. L., Total neutron cross sections for U-235, normal U, and Pu-239, 18: 21203 (LA-1493)
HENRICSSON, Inga-Britt, Recovery rate and dose-reduction factor in cysteamine-treated mice after irradiation, 18: 19775
HENRIE, T. A., Direct electrolysis of UO_2 to U metal, 18: 20448 (BM-RI-6436)
HENSCHEID, J. W., Predicting excess reactivity in the ETR, 18: 21685
HERBERG, R. J., Double-isotope liquid scintillation counting, 18: 19872
HERLITZ, S. I., Runaway electrons in toroidal discharges, 18: 21533
HERMAN, Robert, Inelastic electron-deuteron scattering experiments, 18: 20945
HERMANN, Horst, Removal of rivets from tubular members, 18: 20159
HERMOCH, V., Plasma jets in magnetic fields, 18: 21486
HERNADI, F., Antagonistic actinomycetae in Hungarian soils. VI., 18: 19560
HERNDON, R. C., Eigenvalue of a three-body system, 18: 21048
HERTZBERG, Ola, Recovery rate and dose-reduction factor in cysteamine-treated mice after irradiation, 18: 19775
HESS, A., Semiconductor particle detectors. I., 18: 20349
HESSE, C. O., Cobalt-60 γ irradiator, 18: 20419
HEUFER, Gert, Polymerization of α-methylstyrene by electron irradiation, 18: 20070
HEUSER, H., Portable four-channel spectrometer, 18: 20347
HEUSTROEV, V. D., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
HEYLEN, A. E. D., Townsend's secondary ionization coefficient, 18: 20137
HEYMANN, D., Temporal and spatial variation in cosmic rays, 18: 20815 (BNL-7948)
HIBBERT, N. S., Preparation of ceramic-grade BeO, 18: 20503
HIBINO, Susumu, Bone marrow cells of irradiated rats, 18: 19660
HICKMAN, B. S., Fission-product damage in BeO dispersion fuels, 18: 20615
HICKMAN, B. S., Growth in irradiated BeO single crystals, 18: 20609
HICKMAN, B. S., Irradiation of Be. II., 18: 20579 (AAEC/E-115)
HICKMAN, B. S., X-ray diffraction studies of irradiated BeO, 18: 20608
HICKS, Raymond, Core supporting arrangements for reactor, 18: 21590
HIGGINS, G. M. C., Radiolysis of polyisobutene. II., 18: 20065
HIGGINSON, G. S., Critique and extension of Maier-Leibnitz experiment, 18: 21471
HIGGINSON, G. S., Dissociation in H low-voltage arc, 18: 21466
HIIDA, K., Pseudoscalar charge density of spin-½ particles. II., 18: 20946
HILAL, Sadek K., High-resolution density-gradient separation of bone-marrow cells, 18: 19525
HILBORN, H. S., Prog. rpt. on heavy water reactors, 1/64, 18: 21633 (DPST-64-83-1)
HILDEBRAND, Joel H., Diffusion of H and other gases in CCl_4, 18: 19963

HILDITCH, R. J., Fission-product damage in BeO dispersion fuels, 18: 20615

HILL, H. W., Compatibility of nuclear fuel and thermionic emitter materials, 18: 20876

HILL, R. J., Prog. rpt. on thermionic energy converters, annual, 12/15/62–12/15/63, 18: 20829 (AD-429503)

HILL, Robert F., Development of Ba–U emitter materials, 18: 20877

HINE, Gerald J., Corrections for two-crystal whole-body counter, 18: 20337 (NYO-2553-1)

HINKLE, J. G., Prog. rpt. on application of gas-lubricated bearings, 9–11/63, 18: 20135 (TID-20448)

HINMAN, G. W., GAPLSN—program for solution of one-dimensional anisotropic transport equation, 18: 21123 (GA-4972)

HINNOV, E., Impurity concentrations and electron temperatures in C-stellarator, 18: 21378 (MATT-251)

HINNOV, E., Power balance measurements in C-Stellarator with divertor, 18: 21377 (MATT-247)

HINNOV, Einar, Ionized plasma in He hollow cathode discharge, 18: 21375 (MATT-236)

HINTENBERGER, H., Diffusion loss of radiogenic and spallogenic rare gases from meteorites, 18: 20206

HINTENBERGER, H., Helium and Ne isotopes in Fe meteorites, 18: 20205

HINTENBERGER, H., Production cross sections for He-3 and Ne-21 from stone meteorites, 18: 20204

HINTZ, Eduard, Pressurized trigatrons, 18: 20147

HIRAI, Akira, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979

HIRASAWA, Takeo, Local geomagnetic disturbance in high latitudes, 18: 21079

HIREL, R., Separation of fast particles by means of h-f EM fields, 18: 20925

HIRSCHBERG, Joseph G., Ionized plasma in He hollow cathode discharge, 18: 21375 (MATT-236)

HIRSH, M. N., Prog. rpt. on radiation effects on EM signals in air, 9/30/63, 18: 20618 (NP-13799)

HOBBIE, Russell K., Differential cross sections for $C^{13}(Li^6,\alpha)N^{15}$, 18: 21295

HOBBS, Richard L., Series operation of thermionic diodes, 18: 20883

HOCKER, K. H., Transient discharges across vortex-stabilized arcs, 18: 21522

HODGE, C. A. H., Dating of humus podzols by residual radiocarbon activity, 18: 20223

HOEBEL, M., Secretion of I-131 in thyroidectomized guinea pigs, 18: 19528

HOEGAASEN, H., Polarization operators for s = 1, 18: 20979

HOFF, R. W., Production of transuranium elements in thermonuclear explosion, 18: 20638 (UCRL-7347)

HOFFMAN, E. E., Prog. rpt. on K corrosion test loop experiment, 10/15/63–1/15/64, 18: 20473 (NASA-CR-54008)

HOFFMAN, H. W., Two-phase flow and boiling heat transfer at ORNL, 18: 20171 (TID-7694(p.18-23))

HOFFMAN, R. W., Mechanical properties of thin films, 18: 20515 (CONF-356-11)

HOFMANN, F. W., Impurity concentrations and electron temperatures in C-stellarator, 18: 21378 (MATT-251)

HOFMANN, F. W., Power balance measurements in C-Stellarator with divertor, 18: 21377 (MATT-247)

HOFMANN, Fritz W., Ionized plasma in He hollow cathode discharge, 18: 21375 (MATT-236)

HOFSTADTER, R., Inelastic electron-deuteron scattering experiments, 18: 20945

HOFSTADTER, Robert, High-energy scattering events with small energy losses, 18: 21302

HOGASEN Jacqueline, Pairing force and approximation methods in nuclear spectroscopy, 18: 21216

HOGG, B. G., Fictitious cascades in sum coincidence spectra, 18: 21251

HOIGNE, J., Radiation chemistry of hydrocarbons. X., 18: 20055

HOIGNE, Juerg, Radiation chemistry of hydrocarbons. XI., 18: 20053

HOIGNE, Juerg, Radiation chemistry of hydrocarbons. XII., 18: 20054

HOLADAY, Duncan A., Cancer mortality patterns among U miners and millers, U. S., 18: 20256

HOLLAND, J. W., Correlations on a Cs thermionic converter, 18: 20852

HOLMES, O. G., Strontium into precipitates of Ca fluoride and phosphate, 18: 19949

HOLMGREN, H. D., Differential cross sections for triton-induced reactions on N-14, 18: 21282

HOLTEN, David C., Behavior of He gas thermometers below 77°K, 18: 20286 (UCRL-7327)

HOLTZ, Robert E., Temperature analysis of emitters for electron heating, 18: 20183 (TID-18835)

HOLZAPFEL, L., Radiochemical reactions in the presence of quartz, 18: 20045

HOLZL, R. A., Uniform work function emitter studies, 18: 20863

HONMA, Toshio, Reaction of U with graphite, 18: 19984

HONNEGGER, C. G., Thin-layer ionophoresis, 18: 19854 (SC-T-64-49)

HOPPMANN, R. F., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)

HORNER, M. H., Compatibility of U fuels and thermionic emitters, 18: 20874

HORNYKIEWYTSCH, Theophil, Effects of γ radiation on growing larynx of rabbit, 18: 19700

HORROCKS, Donald L., Quenching of liquid scintillator solutions, 18: 20352

HORST, Raymond H., Chemistry of poly(vinyl chloride) stabilization. III., 18: 20028

HORST, Raymond W., Chemistry of poly(vinyl chloride) stabilization. IV., 18: 20029

HORST, Raymond W., Chemistry of polu(vinyl chloride) stabilization, V., 18: 20030

HORTIG, G., Accelerator for heavy ions, 18: 20699

HORVAT, P., Energy levels of F-21 using $F^{19}(t,p)F^{21}$ reaction, 18: 21255

HOSAKA, Daikichi, Transplantability of Yoshida ascites tumor cells. I., 18: 19651

HOSEGOOD, Samuel Britton, Plant for trapping radioactive fission products, 18: 21584

HOSHINO, Takashi, Myelofibrosis with myeloid metaplasia in survivors of Hiroshima, 18: 19568

HOSLER, W. R., Superconductivity in semiconducting $SrTiO_3$, 18: 21102

HOSOYA, Sukeaki, Parameters for atomic scattering, 18: 20809

HOSTLER, Levere, Coulomb Green's functions and the Furry approximation, 18: 21027

HOTCHKISS, Robert S., Recovery of male fertility after radiation, 18: 19648

HOTZ, G., Experiments in radiation chemistry of T1-phage, 18: 19634

HOUSKA, C. R., Atomic vibration amplitudes for TiC, TiN, ZrC, ZrN, and W, 18: 19987

HOUSTON, J. M., Conference on thermionic conversion, Gatlinburg, 10/63, 18: 20841

HOUSTON, J. M., Emitter heat balance in thermionic converter, 18: 20868

HOUSTON, John M., Dependence of collector work function on emitter temperature, 18: 20869

HOWARD, C. L., Prog. rpt. on BWR fuel cycle program, 10–12/63, 18: 21635 (GEAP-4481)

HOWARD, R. C., Converter performance test of a Re emitter, 18: 20878

HOWARTH, G., Determination of gas discharge temperatures, 18: 21481

HOWER, Glen Lamar, Synchrotron emission from electrons, 18: 21086

HOWLAND, J. W., Acute radiation injury and syndrome, 18: 19588

HOWLAND, Joe W., Amino-acid excretion in accidentally irradiated humans, 18: 19638

HOYLE, F., Origin of cosmic rays, 18: 20827

HRACH, Frank J., Proton fluxes through Van Allen belt, 18: 20816

HRYNKIEWICZ, A. Z., Magnetic interaction excited state of Gd-155 with electronic shell, 18: 21211 (PAN-299)

HSIAO, Chien, Direct production of electron pairs by high-energy charged particles, 18: 21311

HSIEN, Ting-chang, Does there exist a world of very strange nuclei?, 18: 21184 (JINR-P-1583)

HSU, Chio-jung, Heat transfer to liquid metals in cross-flow through rod bundles, 18: 20185

HSU, Lydia S., Reaction of ferricyanide with borohydride in aqueous solution, 18: 19938 (UCRL-11252)

HUAI, Yu-ping, Problems in theory of superconductivity, 18: 21107

HUANG, K., Renormalization group method and high-energy scattering, 18: 20983

HUANG, Y. C., Allotropic transformation characteristics of Ti alloys, 18: 20545

HUBER, R., Influence of AET, MEA, and thioctic acid on Walker-carcinoma with fractionated local irradiation, 18: 19798

HUBER, R., Radioprotective effect of cysteamines, 18: 19788
HUBER, R., Radioprotective effect of antioxidants, 18: 19797
HUBERMAN, M. N., Uniform work function emitter studies, 18: 20863
HUBERT, P., Proceedings of the 6th international conference on ionization phenomena in gases, Paris, 7/63. Vol. II., 18: 20671
HUETTER, T., r^+ analysis, 18: 21018
HUFF, F. A., Radioactive rainout relations on densely gaged sampling networks, 18: 20617 (COO-1199-3)
HUG, O., Instantaneous physiological radiation effects, 18: 19574
HUGGINS, R. A., Motional narrowing of NMR lines in LiF, 18: 19991
HUGHES, V. W., Choice of primary proton energy for meson factory, 18: 21213 (TID-20440)
HUGO, J. P., Materials for reactor technology, 18: 20558
HULL, D. E., Computer routines for activation analysis, 18: 19918
HULSE, E. V., Quantitative cell counts of the bone marrow, 18: 19510
HUNGERFORD, David A., Chromosome changes following irradiation in mammals, 18: 19583
HUNT, Vilma R., Concentrations of α-emitting elements in teeth and bones, 18: 19532
HURWITZ, H., Jr., Calculational technique for stability integral gradients, 18: 21413
HUSEYA, Masayoshi, Determination of Re in Re–W alloy, 18: 19881
HUSON, F. R., Interactions of 17-Bev/c negative pions, 18: 20891 (AD-433625)
HUTTON, D. R., Paramagnetic resonance of Gd^{3+} in zircon, 18: 19945
HUTTON, P. J., Triggering of undervolted spark gaps, 18: 20149
HYRE, H. M., Effect of irradiated cock sperm on hatchability, 18: 19664

I

ICHIKAWA, Yoshiko, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
IDOHARA, Mitsuru, Determination of impurities in Ta by d-c arc method, 18: 19894
IGNATEVA, N. G., Valency of Re during reduction, 18: 20005
IGNATEVA, T. A., Effect of impurities on superconducting transition temperature in Tl, 18: 21113
IGNATOVICH, V. K., Asymptotic value for interaction cross section for two Fermi particles, 18: 20990
IKUSHIMA, Hiroshi, Radiation effects on electronic components. I., 18: 20590
IMAMALIEV, G. N., Effects of γ- and fast neutron irradiation of grafts, 18: 19691
IMAN, M. Manzoorul, Radiation sensitivity of *Triticum*, 18: 19748
IMAZU, Shingo, E vs. B curve hysteresis in the positive column, 18: 21403
IMIG, J. K., 1000-Mwe SGR. 90% ThO_2, 10% UO_2 alternate fuel, 18: 21616 (NAA-SR-Memo-9569)
INCE, Albert, Improvements relating to storage apparatus, 18: 21583
INGRAM, M., Acute radiation injury and syndrome, 18: 19588
INKIN, V. D., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
INNES, J. R. M., Effects of partial-body irradiation on delayed responses, 18: 19586
INOUYE, T., Polonium in urine in Japanese U miners, 18: 19916
INSELBERG, Edgar, Simplified procedures for radioassay of plant materials, 18: 19856
INSINGER, F. G., Measurements on a rotating plasma, 18: 21500
IOFFE, B. L., Restrictions on $e^+ + e^- \rightarrow \pi^+ + \pi^-$ reaction cross section by analyticity condition, 18: 20986
IOKHEL'SON, S. V., Content of Sb-125 in soil cover and in plants, 18: 19516
IONOV, N. I., Probe characteristics in gaseous discharge plasma, 18: 21438
IONOV, N. I., Two-stage magnetic mass spectrometer, 18: 20306
IORDANOV, N., Valency of Re in thiocyanate complex, 18: 20004
IOSSIFIDES, I. A., Survival of skin homografts in mice with bacterial infection, 18: 19511
IOSSIFIDES, Ioulios A., Mortality of sublethally x-irradiated mice, 18: 19727
IRWIN, Ernest John, Jr., Tensor force and the Pauli exclusion principle, 18: 21344
ISAACS, Jim Woolford, Process for the preparation of carbide, 18: 20508
ISBELL, Horace S., Tritium-labeled compounds. X., 18: 20031
ISENHOUR, Thomas L., Times of irradiation and decay in activation analysis, 18: 19874
ISHIDA, M., ABCC-NIH studies of carcinogenesis in Hiroshima and Nagasaki, 18: 19580
ISRAEL, Gerhard W., Direct measurement of atmospheric thoron content, 18: 19893
IVANOVSKII (IVANOVSKIY), D. I., Radiation effects on reproduction of parotitis virus, 18: 19556 (JPRS-23956(p.9-17))
IVANY, Richard D., Void fraction in cavitating Hg, 18: 20167 (NP-13812)
IWAMOTO, Junko, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
IWASE, Akikazu, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
IWAUCHI, Takashi, Bone marrow cells of irradiated rats, 18: 19660
IYER, K. S. S., Fluctuation problem in EM cascades. II., 18: 20978

J

JAAG, O., Monitoring of waters and soil for radioactivity, 18: 20218
JABLON, S., ABCC-NIH studies of carcinogenesis in Hiroshima and Nagasaki, 18: 19580
JABLON, Seymour, Late radiation effects of neoplasia, 18: 19596
JACH, Joseph, Thermal decomposition of irradiated Ni oxalate, 18: 20061
JACKSON, J., Fabrication of fueled BeO, 18: 20497
JACKSON, R. P., Effects of surface grinding on stress corrosion cracking of austenitic stainless steel, 18: 20470 (CONF-492-1)
JACKSON, W. D., Prog. rpt. on energy conversion, 9–11/63, 18: 20834 (NP-13808)
JACOBI, Wolfgang, Radiation protection practice. I., 18: 20274
JACOBS, J. A., Short-period geomagnetic pulsations, 18: 21076
JACOBS, K. C., Fermi-liquid effects in cyclotron resonance, 18: 21047
JACOBS, Laurence, Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
JACOBS, Marion Beckmann, Uranium emplacement near Moab, Utah, 18: 20228
JACOBS, S., Sorption of tritium and tritiated water vapor by foamed polyvinylchloride (ensolite), 18: 20458 (USNRDL-TR-717)
JACQUEMART, Rene, Application of pulsed neutron technique on reactors Alize and Aquilon, 18: 21595 (CEA-R-2376)
JAECH, J. L., Background in mass spectrometry, 18: 19878
JAEGER, R. E., Effect of neutron irradiation on fused silica, 18: 20616
JAFFEE, R. I., Prog. rpt. on W-base sheet alloy, 5/8–8/8/63, 18: 20443 (AD-416199)
JAGADEESAN, K., Heat transfer due to hydromagnetic channel flow, 18: 21392
JAMBOIS, Thomas F., Thermodynamic properties of inorganic substances. VII., 18: 19955
JAMERSON, F. E., Noble gas ionization by fission fragments, 18: 20860
JAMESON, Alexander Keith, Collisions of atoms with diatomic molecules, 18: 20776
JAMESON, Cynthia Juan, Calculation of chemical shifts. II., 18: 19960
JAMISON, H. C., X radiation in dental offices. III., 18: 20261
JANSSEN, E., Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
JASWAL, S. S., Lattice-vibration eigenvectors and applications for NaCl and KCl, 18: 21726 (TID-20487)
JENKINS, V. K., Myeloid leukemia in the mouse, 18: 19577
JENSEN, A. O., Ionization processes in Cs vapor, 18: 20853
JENSEN, A. O., Molybdenum as an electrode material for thermionic converters, 18: 20865
JENSEN, Roy Alfred, Ultraviolet-induced mutation in *Bacillus subtilis*, 18: 19753
JENTSCHKE, W., Electron accelerator Desy, 18: 20695
JEONG, T. H., Absolute gas pressure measurement, 18: 20297
JESS, J., Synthesis of pulse formers, 18: 20317
JESSEPH, John E., Responses of malignant tissue to protons, 18: 19812 (BNL-6966)
JETER, Thomas R., Reducing energy variations of Van de Graaff beam, 18: 20709
JEUNEHOMME, M., Vaporization of sulfides of Ca, Sr, and Ba, 18: 19939 (WADD-TR-60-782(Pt.XXI))

JHA, S., Decay of Sr-83, 18: 21354
JHA, S., Decay of 66-min. In-110, 18: 21355
JIANG, Shou-sheng, Internal fraction due to dislocations in Mo, 18: 20559
JIBUTI, R. I., Nucleon clusters in light nuclei, 18: 21247
JOANOU, G. D., Neutron thermalization in graphite, 18: 21146
JOEST, Karl-Heinz, Prompt-decay constants and correlated spectra in multiplying media. II., 18: 21150
JOEST, Karl-Heinz, Prompt-decay constants and correlated spectra in multiplying media. I., 18: 21149
JOHANSSON, A., Inelastic electron-deuteron scattering experiments, 18: 20945
JOHANSSON, Rolf B., Linear high-current discharge, 18: 21534
JOHNSEN, K., Features of next generation of proton accelerators, 18: 20696
JOHNSON, DeLores E., Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
JOHNSON, G. R. A., Formation of ozone from O by radiations, 18: 20095
JOHNSON, Robert W., High-resolution density-gradient separation of bone-marrow cells, 18: 19525
JOHNSSON, K. O., Publications, reports, and papers for 1963, 18: 21714 (ORNL-3300(Vol.3))
JOHNSTON, A. S., Decay of Sr-83, 18: 21354
JOHNSTON, A. S., Decay of 66-min. In-110, 18: 21355
JOHNSTON, L. H., Absolute gas pressure measurement, 18: 20297
JOKIC, T., Ranges and depth distribution of ions in metals, 18: 20672
JONASSON, L. G., Low-noise solid-state amplifiers for semiconductor detectors, 18: 20366
JONEK, J., Behavior of lung enzymes in acute radiation sickness, 18: 19675
JONEK, Jan, Radiation effects on guinea pig adrenal gland, 18: 19710
JONES, Gerald L., Influence of initial correlations on the approach to equilibrium, 18: 21030
JONES, Jack, Improvements in fluid coupling devices, 18: 21587
JONES, K. A., Sintering studies on ceramic fuel materials, 18: 20483 (AAEC/E-116)
JONES, L. V., Prog. rpt., 10/63, 18: 21707 (MLM-1177)
JONES, L. V., Prog. rpt., 11/63, 18: 21708 (MLM-1178)
JONES, L. V., Prog. rpt., 12/63, 18: 21709 (MLM-1179)
JONES, W. B., Scattering of 65-Mev He ions from O-16, 18: 21260
JONSCHER, A. K., Solid-state plasma phenomena, 18: 21395
JORDAN, Dona L., Fractionated, low dose-rate irradiation of mice, 18: 19576
JORTNER, Joshua, Energy-transfer phenomena in liquid He, 18: 20756
JOSEPH, A. S., Low-field de Haas-van Alphen effect in Cu, 18: 20755
JOSHI, M. C., Nuclear levels of Au-199, 18: 21243
JOSHI, Vishnuprakash, Plasma under the influence of crossed fields, 18: 21442
JOST, Klaus, Distribution of medium-fast electrons in multiple scattering, 18: 21316
JOST, Res, Poisson brackets, 18: 21058
JOUBERT, P. J., Control and instrumentation of South African Research Reactor, 18: 21686
JOUIN, Jacques, Device for adjusting position of elements, 18: 21690
JOVIC RANDIC, Mirjana, Effect of x rays on 5-hydroxytryptamine in experimental animals, 18: 19652
JOY, Hubert W., Radial correlation in He, 18: 20739
JUCKNIESS, Paul R., Production of high-purity Cs, 18: 20117
JUETTE, A., Diagnosis of tumors of eye with radioactive phosphorus, 18: 19823
JUNG, B., Alpha-active isomers in Bi-201 and Bi-199, 18: 21258
JUNG, B., Spin-parity of 53-min Cs-135m, 18: 21265
JUNK, G. A., Deuterium exchange in the pyridoxal–leucine system, 18: 20027
JURA, G., Influence of high pressures on Mossbauer effect in Dy-161, 18: 21214 (UCRL-10630(Rev.))

K

KABANOVA, L. M., Preparation of MoS_2, 18: 20001
KABELA, M., Acute radiation fibrosis of the lung, 18: 19694
KACHAN, A. A., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
KADYK, J. A., Liquid-H Cherenkov counter, 18: 20369
KAECH, Alfred, Magnetohydrodynamic generator, 18: 20890
KAGAN, Yu., Mössbauer effect on Sn-119 in Au, Pt, and Tl matrices, 18: 20007
KAGIWADA, R., Cavitation in liquid He, 18: 20678
KAHN, J. S., Preferred orientation of polycrystalline BeO, 18: 20532 (UCRL-7381-T)
KAINDL, K., Preservation of food and sterilization of pharmaceutical products. A., 18: 19658
KALBFLEISCH, George R., Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
KALIN, T., Anisotropy of diffusion constant in media with empty channels, 18: 21141
KALINKEBICH, I. F., Automatic stabilization of beam of fast atomic particles, 18: 20757
KALINNIKOV, V. G., Decay of Ho-155, 18: 21175 (JINR-P-1479(p.26-34))
KALINNIKOV, V. G., Decay of Dy-155, 18: 21176 (JINR-P-1479(p.35-9))
KALLMAN, Robert F., Early stages of radiation recovery, 18: 19575
KALO, Abdel Magid, Separation of rare earths. XI., 18: 20108
KAMALYAN, L. A., Effects of x radiation on reproduction of smallpox vaccine virus, 18: 19687
KAMALYAN, L. A., Effect of ionizing radiation on virus infections, 18: 19747
KAMALYAN, L. A., Smallpox vaccinal process and formation of antismallpox immunity in rabbits due to x irradiation, 18: 19737
KAMEMOTO, Yuichiro, Behavior of several elements in fused Bi-fused salts system. II., 18: 19983
KAMENETSKII, V. D., Quantum theory of collisions. III., 18: 20735
KAMINKER, D. M., Theory of channel consisting of magnetic quadrupole lenses, 18: 20703
KAMMASH, Terry, Stability of anisotropic plasma against oscillations of the Rayleigh-Taylor type, 18: 21390 (UCRL-7330)
KAMMERER, O. F., Surface superconductivity in type I and type II semiconductors, 18: 21101
KANEKO, Hideo, Allotropic transformation characteristics of Ti alloys, 18: 20545
KANKELEIT, E., Mossbauer effect in Tm-169, 18: 21290
KAPLAN, Harriet, Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
KAPLAN, N., 26.8-Kev state of I-129, 18: 21238
KAPLAN, S., Choosing weighting functions in method of weighted residuals, 18: 20440 (WAPD-T-1576(Rev.))
KAPLAN, S. A., Theory of nonstationary, multiple Compton scattering of γ quanta, 18: 20920
KAPROS, C., Radiation effects on survival of skin homografts, 18: 19605
KARAJOVIC, D., Uranium in the urine of miners, 18: 20271
KARAKHANOV, V. Ye., Voltage-current characteristics and current oscillations in low-pressure thermionic converters, 18: 20840
KARAM, R. A., Nuclear properties of Re, 18: 21205 (NP-13807)
KARASIK, A. S., Counting characteristics of CO_2 detectors, 18: 20397
KARATAEV, V. I., Two-stage magnetic mass spectrometer, 18: 20306
KARIMOV, R., Formation of multiple fragments at proton energy of 660 Mev, 18: 21230
KARIMOVA, R., Angular correlation of fragments and light particles in nuclear fission, 18: 21229
KARLSSON, R. H., Experiments using thermoelectric emf of a Pu–wt.% Ga alloy, 18: 20527 (RFP-351)
KARPMAN, V. I., Theory of turbulent plasma in magnetic field, 18: 21426
KARPOV, Yu. A., Determination of O in rare earth metals oxides and metal fluorides, 18: 19907
KARRAKER, D. G., Isotope recovery from nuclear detonation in salt, 18: 20121 (CONF-470-1)
KARRAKER, D. G., Spectra of UCl_4 in organic solutions, 18: 19935 (TID-18814)
KARSH, Robert, War and medicine, 18: 19793
KARZHAVIN, Yu. A., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
KARZMARK, C. J., Large-field superficial electron therapy with linear accelerators, 18: 19820
KASAK, A., High-strength, elevated-temperature, corrosion-resistant steel, 18: 20446 (ASD-TDR-63-766)
KASHIWAGI, Michio, ESR of x-irradiated hexamethylenediammonium adipate,

18: 20075
KATAYAMA, Meisaki, Radiolysis of cyclopentanone, 18: 20093
KATO, Toshio, Transplantability of Yoshida ascites tumor cells. I., 18: 19651
KATO, W. Y., Safety rpt. on ZPR-VI, 18: 21592(ANL-6271)
KATSUURA, Kenji, Collisional excitation transfer between atoms, 18: 20740
KAURANEN, P., Alpha-active isomers in Bi-201 and Bi-199, 18: 21258
KAVANAGH, R. W., Mass of Ni-56, 18: 21357
KAWADA, Toshiyuki, Hardness and annealing behavior of UO_2, 18: 20544
KAWARABAYASHI, Ken, Some remarks on ω and ϕ meson widths, 18: 20949
KAY, A. E., Specific heat of Pu at high temperatures, 18: 20593
KAZACHKOVSKII, O. D., Physical characteristics of BR-5 reactor, 18: 21683 (ANL-Trans-9)
KAZARINOV, N. M., Spectrometer for fission neutrons, 18: 20384
KAZARINOV, Yu. M., Phase-shift analysis of N-N scattering, 18: 20904 (JINR-P-1553)
KAZNOFF, A. I., Compatibility of nuclear fuel and thermionic emitter materials, 18: 20876
KE, Chiung-Hwei, Chromatographic columns for rare-earth separation, 18: 20109
KEARNS, George B., Lunar mission performance nuclear vehicles, 18: 21674 (NASA-TN-D-2157)
KEARNS, W. J., Magnetic-field design for large ion pumps, 18: 20158
KEESE, H., Decontamination of radioactive H_2O, 18: 20266
KEIDERLING, W., Radiation exposure and radiation protection in medicine, 18: 20254
KEILHACKER, M., Continuum emission of theta pinch, 18: 21529
KEILHACKER, M., Emission from neutral H in θ pinch, 18: 21528
KELEMEN, George, Radiation and ear, 18: 19562
KELLA, J., Transistorized fail-safe high-low trip, 18: 20292
KELLER, D. L., Converter performance test of a Re emitter, 18: 20878
KELLER, W. E., Liquid He-II heat conductivity and fountain pressure, 18: 20798
KELLY, J. W., Growth and properties of single crystals of BeO, 18: 20015
KELLY, P. S., Analytic self-consistent field functions for the configurations $1s^k2s2p^k$, 18: 20759
KEL'MAN, V. M., Vertical focusing of electron beam with cylindrical magnetic lenses, 18: 20704
KENNEDY, J. M., Thermal neutron spectrum in a moderator with temperature discontinuity, 18: 21145
KENNETT, T. J., Decay of 92.5-min La-142, 18: 21270
KENNY, P. J., Total-body scanning, 18: 19818
KENTY, C., Constriction of weak diffuse discharges, 18: 21463
KERBY, Corey C., Collection, storage, and transfusion of peripheral blood leukocytes, 18: 19776
KERLIN, E. E., Prog. rpt. on effects of nuclear radiation, vacuum, and cryotemperatures on engineering materials, 6–8/63, 18: 20581 (FZK-172)
KERMICLE, Jerry L., Gametophyte-dependent variation in expression of R^r maize genes, 18: 19507 (TID-20402)
KERN, Werner, Radioisotopes in semiconductor technology. II., 18: 20420
KERNAN, W., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
KERNS, Quentin A., Evaluation of C-70045A high-speed photomultiplier, 18: 20343 (UCRL-11147)
KERR, Edward, Extending reactor time-to-poison, 18: 21687
KERREBROCK, J. L., Prog. rpt. on energy conversion, 9–11/63, 18: 20834 (NP-13808)
KERTAI, Pal, Effects of irradiated bone marrow on liver regeneration of rats, 18: 19790
KERTAI, Pal, Question of radiotoxins, 18: 19653
KESSEY, Kwadwo Ohemeng, Magnetohydrodynamic rotation of plasmas, 18: 21443
KESSLER, Joachim, Distribution of medium-fast electrons in multiple scattering, 18: 21316
KESSLER, S. W., Cesium compatibility of thermionic converter structural materials, 18: 20873
KESTERKE, Donald G., Direct electrolysis of UO_2 to U metal, 18: 20448 (BM-RI-6436)
KESTIN, J., Viscosity of H isotopes, 18: 19989
KESZTHELYI, Bela, Blood volume changes after P-32 therapy, 18: 19661
KEUFFEL, J. W., Measurement of the rate for $\mu^- + He^3 \rightarrow H^3 + \nu$, 18: 21160 (CONF-231-5)
KHABAKHPASHEV, A. G., Effective light collection by conical light pipes, 18: 20399
KHABAKHPASHEV, A. G., Errors in experiments on coincidence beams, 18: 20382
KHAMYANOV, L. P., Three-rotor mechanical neutron chopper, 18: 20388
KHAN, Mustafa Yar, Emission of uv from metals, 18: 20781
KHANNA, Vishwa Mitter, Properties of Na–K alloys, 18: 20569
KHODZHAEV, L. Sh., Equation for π photoproduction, 18: 20921
KHOLMETSKAYA, A. V., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
KIBLER, G. M., Solid Bi target fabrication, 18: 20486 (MTA-15)
KIENLE, P., Beta decay energy of Tc isotopes, 18: 21319
KIESSLER, R., Construction of spark chamber with transparent metal mesh, 18: 20370
KIKUCHI, Chihiro, VO^{2+} and x-ray produced V^{2+} in Tutton salt, 18: 20059
KIKUCHI, Ken, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
KILBOURN, Joan Priscilla Payne, Protectant from lethal effects of irradiation in mice, 18: 19808
KILIBARDA, M., Uranium in the urine of miners, 18: 20271
KIMELDORF, D. J., Bone growth deficit in x-irradiated rat, 18: 19555 (USNRDL-TR-721)
KINSEY, Denis Victor, Improvements in gas-cooled reactors, 18: 21664
KINTNER, L. L., Containment of Fermi reactor plug, 18: 21641 (NP-13793)
KIRK, B. S., Vapor pressure and heats of vaporization of CO and CO_2, 18: 19933 (NP-13862)
KISELEV, V. S., Phase-shift analysis of N-N scattering, 18: 20904 (JINR-P-1553)
KISHI, Masanori, Anion-exchange behavior of Sc in chloride-thiocyanate media, 18: 20113
KISTEMAKER, J., Measurements on a rotating plasma, 18: 21500
KISTNER, G., Radioactive I in fresh vegetables, 18: 19810
KITAEV, V. Ya., Calculations of mechanical neutron selector in divergent beam geometry, 18: 20385
KITAMURA, S., CdS γ-ray detector, 18: 20351
KITRILAKIS, S. S., Emission from surfaces in Cs vapor, 18: 20862
KLEIN, Ann S., Publications, reports, and papers for 1963, 18: 21714 (ORNL-3300(Vol.3))
KLEIN, Milton M., Diffusion of small particles in nonuniform atmosphere, 18: 20620
KLEMENT, W., Jr., Non-equilibrium structures in Au–Ge alloys, 18: 21727 (TID-20489)
KLEMM, Johannes, Influence of partial-body irradiation on liver functions, 18: 19720
KLEMYSHEV, P. S., Three-rotor mechanical neutron chopper, 18: 20388
KLEPIKOV, N. P., pp-Phase shifts at 657 Mev, 18: 20992
KLINGENSMITH, Raymond W., Elastic scattering of He-3 at 20 Mev, 18: 21359
KLINGENSMITH, Raymond W., Shielding studies on salt slabs, Gd, and water, 18: 21543 (BMI-1384)
KLIWER, James Karl, Nuclear level study of Sc-44, 18: 21339
KLUG, H., Cellular radiation reaction of lymphatic organs, 18: 19674
KLUGER, H., Electron beam melting and welding in nuclear technology, 18: 20491
KNECHTLI, R. C., Auxiliary discharge thermionic energy converter, 18: 20858
KNIAZZEH, A., Current-voltage characteristics of Cs converters, 18: 20849
KNILEY, D. J., Vibration studies of large SGR fuel element, 18: 21615 (NAA-SR-Memo-9164)
KNOOP, Ernst, Radioactivity in milk, 18: 19809
KNOWLES, H. B., Choice of primary proton energy for meson factory, 18: 21213 (TID-20440)
KNOX, J. B., Calculation of explosion-produced craters, 18: 20123 (UCRL-7738)
KNUDSON, A. R., Differential cross sections for triton-induced reactions on N-14, 18: 21282
KNYAZYATOV, A. S., Pulsed source of tritium ions, 18: 20654
KOCHETKOV, N. K., Effect of γ irradiation on glucosamine, 18: 20049
KODIS, Ralph D., Self-quenching cylindrical discharges, 18: 21475
KODOCHIGOV, P. N., Determination of individual radioisotopes in mixture

with β radiation, 18: 19911
KOEHLER, W., Comparison of calculated and measured energy dependence of neutron fluxes, 18: 21608
KOELLER, H., Dosimetry of γ radiation with ferrocenes in CCl_4, 18: 20402
KOEN, J. W., Use of ferrite memory cores, 18: 20371
KOENCKI, Janusz, Radiation effects on guinea pig adrenal gland, 18: 19710
KOENIG, H., Production cross sections for He-3 and Ne-21 from stone meteorites, 18: 20204
KOERTS, L. A. C., Circularly symmetric magnetic field, 18: 20645
KOERTS, L. A. C., Determination of angular distributions with solid state detectors, 18: 21250
KOFFMAN, Donald M., Dispersed phases in refractory metal alloys, 18: 20512 (ASD-TDR-62-7(Pt.II))
KOFSKEY, Milton G., Brayton-cycle space-power-generation systems, 18: 21679
KOGAN, V. I., Theory on broadening spectral lines in plasma, 18: 21405
KOGAN, V. S., Isotopic effects in structural properties of H isotopes, 18: 20008
KOHEGYI, F., Measurement of H-3 with liquid scintillator. I., 18: 19890
KOHEGYI, F., Measurement of tritium with liquid scintillator. II., 18: 19891
KOHN, Henry I., Glomerulosclerosis in the Chinese hamster after x irradiation, 18: 19672
KOHN, R., Detection of free radicals in irradiated fats, 18: 20086
KOIKE, Masahiro, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
KOJIMA, Ken-ichi, Prog. rpt. on population dynamics in evolution of mutant genes, final, 12/60–11/63, 18: 19506 (TID-20401)
KOLANCZYK, B., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
KOLARIK, Z., Isolation of long-lived fission products from radioactive wastes. I., 18: 20102 (UJV-850/63)
KOLASINSKI, Wojciech A., Proton spin flip and substate excitation in inelastic scattering, 18: 21252
KOLB, J. W., Waste management program, 18: 21691 (HW-77163)
KOLBANOVSKII, Yu. A., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
KOLESOV, V. E., Cross sections for excitation of levels of Mg, Cr-52, Ni-58, Ni-60, and Nb-93, 18: 21217
KOLLER, E. L., τ^+ analysis, 18: 21018
KOLLMANN, George, Chemical protection against radiation in tumor-bearing mice, 18: 19774
KOLLMANN, George, Distribution and metabolism of MEG and GED in protected mice, 18: 19772
KOLLMANN, George, Protein-bound protective agent in tissues of mice, 18: 19773
KOLLMER, W. E., Influence of diets on radiostrontium retention in skeleton of mammals, 18: 19533
KOLLMORGEN, Gerald Mark, Concentration of rat serum proteins after x irradiation, 18: 19754
KOLPAKOV, O. A., Wave propagation in structural waveguide, 18: 20623 (JINR-P-1565)
KOMAR, V. E., Radiation effects on DNA nucleotide composition, 18: 19682
KONDRAT'EV, B. V., Attenuation in spiral wave guide, 18: 20315
KONDRAT'EV, L. N., Activation cross section of Cd-108 by thermal neutrons, 18: 21220
KONECNY, Ewald, Mass spectrograph for analysis of fission-product beams, 18: 20311
KONECNY, Ewald, Mass spectrographic separation of ion beams fission of U-235, 18: 20312
KONECNY, Milos, Acute radiation fibrosis of the lung, 18: 19694
KONDRIENKO, A. M., Specific energy loss in calculations of mean doses of α particles, 18: 20262
KONONENKO, V. I., Microwave emission in an electrodeless induction discharge, 18: 21394
KONSTANTINOVA, M. M., Mechanism of cystamine radiation protection, 18: 19800
KONUMA, M., Antiproton-proton collision in unitary symmetry model, 18: 20953
KONUMA, M., Experimental test of unitary symmetry model, 18: 20962
KOONTZ, R. L., Leakage through cracks and capillaries in concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)
KOPALEISHVILI, T. I., Nucleon clusters in light nuclei, 18: 21247
KOPFERMANN, H., Nuclear quadrupole moment of Rb-87, 18: 21314
KOPITZKI, K., Study of cathode sputtering of metal crystals, 18: 20785
KOPP, P. M., Radiation protection of aqueous polyvinylpyrrolidone solutions by thiourea, 18: 20056
KOPPENDORFER, W., Compression of plasma in hard-core pinch, 18: 21523
KOPYLOVA, D. K., Mean number of π^0 mesons produced in inelastic π^--p collisions, 18: 20902 (JINR-E-1557)
KORDIS, J., BeO–MgO system, 18: 20577
KORKISCH, J., Separation of U from Th and rare earths, 18: 20114
KORNEFF, T., Shunting mechanisms in exploding wires, 18: 21536
KORNEICHUK, A. A., Octupole states of even-even strongly deformed nuclei, 18: 21172 (JINR-E-1561)
KOSICHENKO, L. P., Diurnal periodicity of mitosis in mice after irradiation, 18: 19610
KOSMIDER, St., Behavior of lung enzymes in acute radiation sickness, 18: 19675
KOSOKAWA, Tetsuzo, Formation stage of spark breakdown, 18: 20146
KOTESWARA RAO, N. V., Fluctuation problem in EM cascades. II., 18: 20978
KOTOV, V. I., Wave propagation in structural waveguide, 18: 20623 (JINR-P-1565)
KOUNTZ, R. Rupert, Radioactive waste water distillation data and costs, 18: 21695
KOUNTZ, S., Radiation effects on survival of skin homografts, 18: 19605
KOURIM, V., Isolation of long-living fission products from radioactive wastes. I., 18: 20102 (UJV-850/63)
KOVACS, P., Antagonistic actinomycetae in Hungarian soils. VI., 18: 19560
KOVALENKO, S. S., Probability of ternary fission of U-235 and U-238, 18: 21219
KOWALCZYKOWA, Janina, Resistance of C_{57} black mice to irradiation leukemia, 18: 19663
KOWALSKI, Kenneth Lawrence, Two-body formulation of scattering problems, 18: 21337
KOWARSKI, Avinoam, Stability of tritium label in 1,2-H^3-D-aldosterone, 18: 19543
KRACIK, Jiri, Theoretical conception of nature of tube silent discharge, 18: 21454
KRAMERS, H. C., Second sound and dissipative processes in dilute He^3–He^4 mixtures, 18: 20802
KRAMERS, W. J., Chemical interaction of oxides with metals, 18: 19981
KRAMPITZ, G., Copolymerization of amino acids by irradiation with fast electrons, 18: 20074
KRASS, Allan S., Relativistic model field theory, 18: 21039
KRAUCH, C. H., Reaction mechanism of Diels-Alder reaction, 18: 20088
KRAUSE, H., Treatment of low-level radioactive effluents, 18: 21692
KRAUSE, M. O., Ionization of Kr by x rays, 18: 20730 (CONF-481-7)
KRAUSE, Manfred O., Atomic readjustment to inner shell vacancies in Ne and Ar, 18: 20729 (CONF-481-6)
KRESNIN, A. A., Equilibrium form of light nuclei, 18: 21307
KRESTOVNIKOV, A. N., Preparation of Nb by reduction of $NbCl_5$, 18: 20009
KREZDORN, W., Experiments on the low-voltage arc, 18: 20851
KRIEGEL, H., Influence of diets on radiostrontium retention in skeleton of mammals, 18: 19533
KRIEGEL, Henix, Effects of fractionated x irradiation on embryonic development of the mouse, 18: 19719
KRIMMEL, E., Wave optics intensity distribution in line focus of spectrometers, 18: 20407
KRISTENSEN, P., Formulation of dynamical laws in quantum theory of fields, 18: 21023 (NP-13878)
KRISYUK, I. T., Contribution of I and Br isotopes in emission of delayed neutrons, 18: 21221
KRITZINGER, J. J., Relation between impulse corona and breakdown, 18: 21489
KRIVOKHATSKII, A. S., Spontaneous fission of Cm-244 with emission of long-range α particle, 18: 21222
KROELL, W., Inhomogeneous thermal plasma column, 18: 21469

KROEHERT, H., Dosimetry of γ radiation with ferrocenes in CCl_4, 18: 20402
KROLIKOWSKI, W., Baryons and leptons and group SU_4, 18: 20931
KRONBERGER, H., Role of dispersed fuels in the AGR, 18: 21659
KROPP, W. R., Limits on solar neutrino flux and elastic scattering, 18: 20713
KRTIL, J., Isolation of long-living fission products from radioactive wastes. I., 18: 20102 (UJV-850/63)
KRUEGER, G. A., Secretion of I-131 in thyroidectomized guinea pigs, 18: 19528
KRUGER, Paul, Radiochemical fallout study of a Pacific cyclonic storm, 18: 20215
KR[illegible]LOV, S. P., Extrapolation ion chamber for high-energy γ radiation, 18: 20394
KRUSKAL, M. D., Kinetic theory of weakly coupled gases, 18: 21376 (MATT-238)
KRUSKAL, M. D., Stability of plane MHD shocks, 18: 20649
KRUSZYNA, Robert, Resistivity measurements, Hardhat event of Project Nougat, 18: 20200 (ARA-1054)
KRYSZEK, S. H., Role of public health inspector in disaster, 18: 20252
KUAN, Hsin-Mia, States in O-15 and N-14 from He^3-induced reactions, 18: 21336
KUCAN, Z., Effect of x irradiation on degradation of DNA in *E. coli*, 18: 19641
KUCAN, Z., Effect of repeated x irradiation on degradation of DNA, 18: 19656
KUCHEROV, R. Ya., Voltage-current characteristics and current oscillations in low-pressure thermionic converters, 18: 20840
KUDRYASHOV, L. I., Effect of γ irradiation on glucosamine, 18: 20049
KUFFEL, E., Breakdown of gaps in electron attaching gases, 18: 20148
KUHN, J. W., Safety in industrial use of radioactive sources, 18: 20253
KULCSAR, G., Antagonistic actinomycetae in Hungarian soils. VI., 18: 19560
KULIKOVSKII, A. G., Boundary layer on plane in anisotropic MHD, 18: 20642
KULYUKIN, M. M., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
KUME, Kiyoshi, Nuclear magnetic resonance in ScN and VN, 18: 19980
KUMEKIN, Yu. P., Polarization investigation in proton scattering at high energy, 18: 20383
KUMEKIN, Yu. P., pp-Phase shifts at 657 Mev, 18: 20992
KUMMERER, K., Oxygen evaluation in Na, 18: 19919
KUMMERER, K., Selection of liquid metals in reactor technology, 18: 20192
KUNII, A., Role of lymphoma virus in x-ray induction of myeloid leukemia, 18: 19578
KUNIN, Robert, Ion exchange, 18: 19859
KUNLINSKI, S., Motion of charged particle in magnetic field, 18: 21383 (NP-13852)
KUO, T. K., Model for $\pi\omega$ resonance at 1220 Mev, 18: 20958
KUPER, C. G., Structure and mobility of ions in liquid He, 18: 20804
KUPP, Robert W., Nuclear power economics, 18: 21656
KUPRIYANOV, S. E., Ionization encounters of electrons with ions and atoms, 18: 20768
KURNICK, N. B., Abscopal effects and bone-marrow repopulation in man and mouse, 18: 19592
KURODA, Rokuro, Anion-exchange behavior of Sc in chloride-thiocyanate media, 18: 20113
KURSANOV, Yu. V., Source of high-intensity protons, 18: 20690
KURTMULLAEV, R. Kh., Rayleigh-Taylor instabilities in conical plasma accelerator, 18: 21428
KURZ, Richard John, Distribution of neutrons in inelastic π^-–p interactions, 18: 21011
KURZWEG, Ulrich H., Dissipative Couette flow between rotating cylinders, 18: 20191
KUSNETZ, H. L., Radon and Rn-daughter products in mines, 18: 20268
KUTTIG, Helmut, Observations of skin reactions in telecesium therapy, 18: 19716
KUZIN, A. M., Effects of γ irradiation of seeds on development of nicotiana plants, 18: 19690
KUZ'MIN, A. M., Microhardness of crystals of natural zircon, 18: 19953
KUZMYAK, M., Ion source for 1-Mev photon accelerator, 18: 20691
KUZNETZOVA, N. E., Neuro-gumorale substances of dog blood during radiation sickness. I., 18: 19683
KUZOVNIKOV, A. A., Compression of plasma column, 18: 21518
KUZOVNIKOV, A. A., Quasi-potential in low-temperature plasma, 18: 21519
KYCIA, T., Beam profile indicator with solid state detectors, 18: 20327 (BNL-7880)

L

LABBE, C., Properties of BeO before and after irradiation, 18: 20605
LABEYRIE, J., Solid-state detectors as energy spectrometers for cosmic high-energy particles, 18: 20410
LACY, L., Thrust units for power-limited propulsion systems, 18: 20639
LADIK, J., Mutagenic effect of ultraviolet radiation, 18: 19650
LA GINESTRA, Aldo, Calcium and Zr phosphate, 18: 19944
LAJTHA, L. G., Fasted mouse in the study of bone-marrow stem-cell kinetics, 18: 19636
LAJTHA, L. G., Stem-cell kinetics after irradiation, 18: 19635
LALA, P. K., Cell proliferation in bone marrow, 18: 19509
LALA, P. K., Influence of β radiation on hemic elements in chronic leukemias, 18: 19789
LAMBERTS, H. B., Radiomimetic toxicity of ozonized air, 18: 19538
LAMBREV, Zh., Natural radioactivity of organisms. I., 18: 19517
LAND, C. C., Thermal expansion of PuC and UC–PuC solid solution, 18: 20522 (LADC-5788)
LANDAUD, G., Measurement of half lives of unstable states of radioelements, 18: 21249
LANE, William B., Plant uptake of radioelements from soil, 18: 19515 (NP-13796)
LANGENDORFF, Hanns, Effects of serotonine on fertility of irradiated mice, 18: 19711
LANGENDORFF, Hanns, Effects of fractionated x irradiation on embryonic development of the mouse, 18: 19719
LANGENDORFF, Margarethe, Effects of serotonine on fertility of irradiated mice, 18: 19711
LANGLOIS, G., Corrosion of metallic materials by UF_6, 18: 20469 (CEA-2385)
LANGPAPE, R., The thermionic element and space navigation, 18: 20837
LANZA, Vincent L., Irradiation [of polymers]—properties changes, 18: 20089
LA PAZ, Jean, Quality surveys from vendor's point of view, 18: 21718 (SC-R-64-135)
LAPP, Thomas William, Neutron irradiation of some crystalline amides and amidines, 18: 20092
LARIN, F., Electronic design approaches, 18: 20304
LARSEN, R. C., Particles with a charge of $\frac{1}{3}$ e, 18: 20952
LARY, E. C., Fluctuations in a gyro-dominated plasma, 18: 21506
LA SALLE, M., Inhibition of DNA synthesis in murine bone-marrow cells, 18: 19524
LASHUK, A. I., Cross sections for excitation of levels of Mg, Cr-52, Ni-58, Ni-60, and Nb-93, 18: 21217
LATHROP, Katherine A., Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)
LATYPOV, Z. Z., Ionization encounters of electrons with ions and atoms, 18: 20768
LAUCHLAN, Ian E. B., Void fraction in cavitating Hg, 18: 20167 (NP-13812)
LAUER, K. F., Determination of Co content of solution, 18: 19842 (EUR-581.f)
LAUG, E. P., FDA's radioactivity program, 18: 20255
LAUGHLIN, J. S., Total-body scanning, 18: 19818
LAURENT, B., Elementary-particle theory, 18: 20910 (NP-13837)
LAUSTRIAT, Gilbert, Liquid scintillation counters, 18: 20335 (NP-13840)
LAWERGREN, B. T., Low-lying levels of Al-27. I., 18: 21256
LAWRANCE, J. J., Adsorption of water and CO_2 on BeO, 18: 20014
LAWRENCE, J., Analysis of parallel plane Cs thermionic converter, 18: 20855
LAWRENCE, J. H., Beta irradiation of dog lymphatic structures, 18: 19601
LAWRENCE, Pope A., Cancer mortality patterns among U miners and millers, U. S., 18: 20256
LAWSON, Kenneth D., NMR studies of adsorption on metal oxides,

18: 20632 (TID-18689)
LAX, Peter D., Solutions of nonlinear hyperbolic partial differential equations, 18: 20441
LAYRISSE, Miguel, Prog. rpt. on radioisotope study of intestinal absorption in hookworm infected patients, 9/61–8/63, 18: 21724 (TID-20404)
LAZAREV, B. G., Critical magnetic fields of superconducting Nb films, 18: 21114
LAZAREV, B. G., Effect of impurities on superconducting transition temperature in Tl, 18: 21113
LAZAREVA, L. S., Effect of impurities on superconducting transition temperature in Tl, 18: 21113
LAZOVSKAYA, A. V., Local anesthesia in irradiated animals, 18: 19612
LEA, R. M., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
LEARY, J. A., Electrorefining of Pu from Pu–Fe alloys, 18: 20099 (LA-3029)
LEARY, J. A., Thermal expansion of PuC and UC–PuC solid solution, 18: 20522 (LADC-5788)
LEBEDEV, L. E., Singular resolutions in spinor field theory and classes of fermions, 18: 21024
LECKEY, C. G., Dissociation in H low-voltage arc, 18: 21466
LEDDICOTTE, G. W., Nucleonics, 18: 19867
LE DUIGOU, Y., Determination of Co content of solution, 18: 19842 (EUR-581.f)
LEE, D. H., Effect of rod spacing on burnout in simulated rod bundle, 18: 20161 (AEEW-R-178)
LEE, Hong, Vulnerability of water facilities to contamination from nuclear attacks, 18: 20233 (NP-13806)
LEE, Jong Sun, Radiation resistance *Micrococcus radiodurans*, 18: 19751
LEE, L. L. Jr., Elastic scattering of protons, deuterons, and α particles from Cu, Ni, and Fe, 18: 21292
LEE, M. J. G., Matching of waveguide coupler for r-f separator deflecting structure, 18: 20679 (CERN-64-14)
LEFEVRE-LE GENTIL, Marie-Cecile, Sensitivity of AgBr crystals in ionographic emulsions, 18: 20336 (NP-13851)
LEFFERT, C. B., Noble gas ionization by fission fragments, 18: 20860
LE FOLL, Jean, Cooling arrangements for fuel elements, 18: 21624
LE FRANC, J. D., Nuclear vapotron, 18: 21617 (TID-7694(p.71-84))
LEGG, J. C., (p,d) Reactions on nuclei from V to Ni, 18: 21291
LEGGE, I. K., Sealed-source regulations, 18: 20242
LEHMANN, J., Radiochemical reactions in the presence of quartz, 18: 20045
LEIKIN, E. M., Energy resolution in cascade γ spectrometer, 18: 20387
LEIMDOERFER, Martin, Monte Carlo methods for γ transport problems, 18: 20932
LEIPUNER, L., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
LEIPUNER, L. P., Particles with a charge of $\frac{1}{3}$ e, 18: 20952
LEITH, D. W. G. S., Wedge shaped scintillation counter, 18: 20353
LEKSIN, G. A., Resonance "singularities" in systems of two baryons, 18: 20911 (NP-13873)
LELEU, G., Petroleum-based organic coolants for reactors, 18: 19836 (EUR-496.f)
LEMAITRE, Rene, Flow-limiting devices for pressure tube assemblies, 18: 21585
LEMANCZYK, D., Radiation protection of rat lungs, 18: 19807
LEMCOE, M. M., Vibration studies of large SGR fuel element, 18: 21615 (NAA-SR-Memo-9164)
LEMMON, A. W., Jr., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
LEMMON, A. W., Jr., Thermodynamic and transport properties of K, 18: 20018
LENGLER, H., Measurements of electron cascades in Pb, 18: 20669
LENGYEL, Tamas, Preparing some carrier-free isotopes, 18: 20071
LENZ, F., Wave optics intensity distribution in line focus of spectrometers, 18: 20407
LENZI, Giuseppe, Behavior of clay materials passing radioactive solutions, 18: 21696
LEONARD, Anthony, Energy-dependent neutron transport theory, 18: 21153
LEPEKHIN, A. T., Magnetic-ionization manometer with high sensitivity, 18: 20198
LESSEL, Wilhelm, Radiation-protection pastes for use in weak radiotherapy, 18: 19832
LESSING, Peter, Sr-87/Sr-86 ratios in Hawaiian lavas, 18: 20216
LEVAY, B., Measurement of H-3 with liquid scintillator. I., 18: 19890
LEVAY, B., Measurement of tritium with liquid scintillator. II., 18: 19891
LEVCHENKO, S. I., Vertical focusing of electron beam with cylindrical magnetic lenses, 18: 20704
LEVEE, Richard D., K-shell photoelectric cross sections from 200 kev to 2 Mev, 18: 20753
LEVEE, Richard D., Polarization correlations in atomic photoeffect, 18: 20754
LEVINE, Jules D., Dimensionless parameter characterizing electron emission S-curves, 18: 20866
LEVINE, Morton A., Vaporization in exploding wires, 18: 21535
LEVI SETTI, R., Production of hyperfragments, 18: 20938
LEVY, E., Analysis of $Eu(C_2O_4)_3$ and Eu(II) salts, 18: 19897
LEVY, Peter M., Magnetic behavior of $GdCl_3 \cdot 6H_2O$, 18: 19988
LEVY, S., Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
LEWINS, Jeffery, Design of nuclear power reactors, 18: 21648
LEWIS, J. C., Lithium-drifted Si surface-barrier detector, 18: 20355
LEWIS, J. P., Transplantation potential of hematopoietic tissue, 18: 19527
LEWIS, J. P., Transplantation potential of fresh and stored bone marrow, 18: 19777
LEWIS, T. J., Motion of cold-cathode arcs, 18: 20144
LEWIS, W. B., Two-group material bucklings in two-region system, 18: 21606
LEYCURAS, Yvonne, D-c discharges in He under pressure, 18: 20640
LEYPUNSKII, A. I., Physical characteristics of BR-5 reactor, 18: 21683 (ANL-Trans-9)
LI, A. C., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
LI, M. C., Orbital angular momenta in $\Sigma^{\pm}$ mesonic decays, 18: 20914 (TID-20488)
LI, Peng-sheng, Mechanism of mass transfer from gas bubbles, 18: 20189
LIANG, Shu-chuan, Spectrophotometric determination of rare earth elements, 18: 19895
LIBBY, Hugo Leander, Measurement of metal temperature, 18: 20282 (HW-SA-3035)
LIBBY, W. F., Search for natural Cm-247, 18: 20217
LIBOVE, Abraham H., Survival experience of the radium cases, 18: 19551 (NYO-2762)
LIEB, D. P., Emission from surfaces in Cs vapor, 18: 20862
LIEBER, A., Scattering chamber for solid state detectors, 18: 20688
LIERMANN, Jean, Device for aligning fuel cartridges, 18: 21621
LIERMANN, Jean, Device for transmission of potential difference, 18: 21622
LIGOU, J., Tridimensional theory of heterogeneous reactors, 18: 21560
LIN, Ching-Yu, Chromatographic columns for rare-earth separation, 18: 20109
LIN, Chun C., Absolute electron excitation cross sections of He, 18: 20752
LIND, Don L., High-resolution γ spectrometry, 18: 20342 (UCRL-10781)
LINDACKERS, K. H., Control rods for nuclear reactors, 18: 21574
LINDBLOM, G., Radioactivity from nuclear weapons test, 18: 20212 (NP-13846)
LINDEN, Walfried A., Walker carcinomas after single irradiation with Co-60, 18: 19699
LINDENBAUM, A., Distributions of polymeric tetravalent Pu-239, 18: 19669
LINDER, Bruno, Cross sections and isomer ratios for isomeric pair Y-90g and Y-90m, 18: 21279
LINDROOS, Bjoern, Radiation effects on epidermal hyperplasia in mice. VI., 18: 19704
LINGENFELTER, R. E., Production of C-14 by solar protons, 18: 20817
LINGENFELTER, R. E., Solar neutrons and the earth's radiation belts, 18: 20820
LINHART, J. G., Collapsing cylindrical metallic foils, 18: 21537
LINIECKI, Julian, Kinetics of Sr-90 accumulation in body, 18: 20235 (NP-13868)
LINN, DuVon Wayne, Effects of Ra on goldfish, 18: 19756
LINN, V. Gordon, Absolute decay rate for $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, 18: 20956
LIPKIN, Daniel M., Existence of a new conservation law in electromagnetic theory, 18: 21083

LIPPINCOTT, Stuart W., Responses of malignant tissue to protons, 18: 19812 (BNL-6966)
LIPSCOMB, William N., Perturbed Hartree-Fock calculations. II., 18: 19958
LIQUORI, A. M., Solid-state polymerization of trioxane, 18: 20032
LITTLE, R. B., Effect of rod spacing on burnout in simulated rod bundle, 18: 20161 (AEEW-R-178)
LLACER, J., Surface effects in thick Li-drifted Si radiation detectors, 18: 20326 (BNL-7853)
LLEWELLYN-JONES, F., Cathode electron emission and vacuum breakdown, 18: 20139
LLEWELLYN-JONES, F., Ionization and attachment coefficients, 18: 21470
LLEWELLYN-JONES, F., Ionization in He, 18: 21472
LOASBY, R. G., Specific heat of Pu at high temperatures, 18: 20593
LOCHAK, G., On the irradiation of an interior target in circular accelerator, 18: 20687
LOCK, W. O., Easter school for emulsion physicists, St. Cergue, 3/63, 18: 20895 (CERN-64-6)
LOEB, Leonard B., High-voltage- and high-pressure discharges, 18: 21480
LOGAN, Douglas, Stress analysis of SCTI mixing tees, 18: 21567 (NAA-SR-Memo-7485)
LOGSDAIL, D. H., Electrolytic dissolution of nuclear fuel elements, 18: 20115
LOKEN, Merle K., High-resolution density-gradient separation of bone-marrow cells, 18: 19525
LOMAKINA, L. Ya., Mitosis and interkinesis in mouse tissues, 18: 19609
LOMBARDI, C., Pressure drops in steam–water mixtures, 18: 20164 (EURAEC-1004)
LOMELIN, Juan M., Electric conductivity of K thiocyanate, 18: 19930 (COO-1044-12)
LOMER, P. D., Pulsed neutron source for reactor measurements, 18: 21605
LONG, James D., Series operation of thermionic diodes, 18: 20883
LONGLEY, William Warren, Jr., Transport properties of a quantum system, 18: 21070
LOPATIN, I. V., Extrapolation ion chamber for high-energy γ radiation, 18: 20394
LOPUSHINSKY, William, Effect of water movement on ion movement into xylem of tomato roots, 18: 21723 (TID-18877)
LORAS, Bernadette, Stability of tritium label in 1,2-H^3-D-aldosterone, 18: 19543
LORENZ, Werner, Differences of radiation injury to testes of rats, 18: 19709
LOS, J., Separative power of short countercurrent columns, 18: 20433
LOTHE, Johan, Improvements in gas-cooled reactors, 18: 21664
LOU, F. E., Renormalization group method and high-energy scattering, 18: 20983
LOUP, M. P., X-ray emission by electron bombardment of the anode, 18: 21502
LOUTIT, J. F., Biology of radiation-induced cancer, 18: 19595
LOW, F. E., Vacuum trajectory in conventional field theory, 18: 21063
LOZHKIN, O. V., Angular correlation of fragments and light particles in nuclear fission, 18: 21229
LU, Ho-nien, Direct production of electron pairs by high-energy charged particles, 18: 21311
LUBITZ, C. R., Theoretical calculation of (n,p) cross sections, 18: 21165 (CONF-490-1)
LUCHNER, K., Nuclear resonance absorption of Fe-57 in ZnS phosphors, 18: 20003
LUDWICK, J. D., Liquid scintillation counting of Pm-147, 18: 19875
LUDWIG, G. H., Spacecraft information systems, 18: 20412
LUDWIG, G. H., U. S. program for particles and fields measurements in space, 18: 21090
LUEBKE, H.-J., Mass effect in ion migration in solutions, 18: 20112
LUECK, H., Detection of free radicals in irradiated fats, 18: 20086
LUEHRS, G., Construction of $\pi\sqrt{2}$ spectrometer and investigation of conversion line spectra of In-144m, 18: 21313
LUISADA, August Guido, Shield for ionizing radiations, 18: 21547
LUMB, M. D., Scintillation spectra of organic solutions, 18: 20046
LUO, H. L., Non-equilibrium structures in Au–Ge alloys, 18: 21727 (TID-20489)
LURIE, D., Matrix elements of the octet operator of SU_3, 18: 20922
LUZYANIN, I. D., Vertical focusing of electron beam with cylindrical magnetic lenses, 18: 20704
LVOV, S. N., Magnetic susceptibility of silicides of conducting metals, 18: 20541
LYCZKO, F. J., Development of gasoline-fueled thermionic engine, 18: 20887
LYMAN, John, Sensitive embryonic sites in Tribolium, 18: 19668
LYNN, Y. M., Moderately strong oblique shocks and simple waves in steady MHD flow, 18: 20630 (NYO-10436)
LYON, C. E., Decreasing extraction by processing solvents of nitrosyl-ruthenium nitrato-complexes from HNO_3 solutions. I., 18: 19924 (AERE-R-4537)
LYON, G. A., Fabrication of fueled BeO, 18: 20497
LYONS, M. F., UO_2 fuel capability, 18: 21620
LYUBEMOV, G. A., Pre-electrode potential variations in weak current passage through ionized gas, 18: 20661
LYUBIMOV, G. A., Boundary layer on plane in anisotropic MHD, 18: 20642
LYUBIMOV, V. B., Mean number of π^0 mesons produced in inelastic π^--p collisions, 18: 20902 (JINR-E-1557)

M

MA, Siu-choun, Initial leucocytosis after γ irradiation, 18: 19697
MAASS, Heinrich, Nucleoside phosphate in organs of rats after whole-body irradiation, 18: 19702
MAC DONALD, W., Field emission from semiconductors, 18: 20152
MAC DONALD, W. M., Photonuclear reactions in a unified theory, 18: 21364
MAC FARLANE, A. J., Matrix elements of the octet operator of SU_3, 18: 20922
MAC KAY, Colin, Studies of reactions of atomic C, 18: 20022 (CONF-322-10)
MACKE, E., Visualization of nucleate boiling of water, 18: 20162 (EUR-1622.f)
MACKINTOSH, A. R., Positron annihilation in rare-earth metals, 18: 20552
MAC LEOD, John, Recovery of male fertility after radiation, 18: 19648
MADDOCK, R. S., Neutrons for small laboratories, 18: 21139
MAEJIMA, Toru, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
MAEKAWA, K., Fabrication of BeO–UO_2–Be fuel pellets, 18: 20504
MAERKL, H., Calculating fast fission effect in coaxial cylindrical lattice cells, 18: 21609
MAGAT, Michel, Production of graft copolymers, 18: 20096
MAGISTRELLI, Franco, Experiments on space charge sheaths, 18: 21373 (EUR-495.i)
MAHN, C., Measurements of a stationary d-c He arc, 18: 21484
MAIER-LEIBNITZ, H., Beams of homogeneous energy from low-energy accelerators, 18: 20706
MAILYAN, E. S., Influence of decortication on hemopoiesis of irradiated dogs, 18: 19733
MAIMONI, A., Thermal conductivity of rock salt, 18: 20530 (UCRL-6894 (Rev.II))
MAITLAND, A., Spark conditioning of electrodes, 18: 20141
MAJEWZKI, Michal, Table of angular momentum weight factors $Z_{n+1}(l_1, \ldots, l_n, L)$, 18: 21212 (PAN-335/VI)
MAKAIMOVIC, Zoran, Production and use of tritium, 18: 20431
MAKAROV, V. I., Effect of impurities on superconducting transition temperature in Tl, 18: 21113
MAKI, Takeshi, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
MAKIN, M. J., Thermal activation of slip in neutron-irradiated Cu, 18: 20594
MAKINS, Roger, Nuclear energy achievements and prospects, 18: 21740
MALAMOS, B., Prog. rpt. on radiation effects on lipid metabolism, final, 5/15/61–3/15/64, 18: 19552 (NYO-2769-1)
MALE, J. C., Electronic excitation of diamond, 18: 20746
MALESANI, G., Experiments on breakdown phenomena in theta-pinch, 18: 21530
MALKIN, L. Z., Spontaneous fission of Cm-244 with emission of long-range α particle, 18: 21222
MALM, John G., Chemistry of the noble gases, 18: 19997
MALMBERG, Philip R., Ray-tracing method for ion-optical measurements,

18: 21022
MALONEY, M. A., Cell proliferation in bone marrow, 18: 19509
MALTBY, George L., Progressive ThO_2 myelopathy, 18: 19659
MALTSEV, E. I., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
MALTSEV, V. V., Pulsed source of tritium ions, 18: 20654
MAMANTOV, Gleb, Chronopotentiometric studies of Fe in molten fluorides, 18: 19966
MAMASAKHLISOV, V. I., Nucleon clusters in light nuclei, 18: 21247
MAMYRIN, B. A., Suppression of noise for observing NMR signals, 18: 19995
MANDEL, H., Future of power generation, 18: 21645
MANDEVILLE, C. E., Nuclear energy states of In-115, 18: 21289
MANDL, F., Single pion production in π–N scattering, 18: 20964
MANDUCHI, C., Decay of Sn-133, 18: 21267
MANDUCHI, C., Polarization of protons scattered from C-12, 18: 21300
MANI, G. S., Absolute photopeak efficiency for well-type NaI(Tl) crystal, 18: 20076
MANI, G. S., Analyzing γ spectra using a computer, 18: 21248
MANI, H. S., Feinberg-Pais theory of weak interactions. II., 18: 20950
MANINGER, R. C., Predicting time-of-burst of exploding wires, 18: 20634 (UCRL-7177)
MANN, D. B., Prog. rpt. on cryogenic magnetic refrigeration, 2/64, 18: 21095 (NBS-8239)
MANN, L. G., Circular polarization of γ rays following β decay of Al-24 and Na-24, 18: 21269
MANNELLI, I., Observation of $P \rightarrow 2\pi^0$, 18: 20960
MANNEY, Thomas, Molecular and cellular effects of ionizing radiations, 18: 19571
MANNING, D. L., Chronopotentiometric studies of Fe in molten fluorides, 18: 19966
MANNING, G. K., Properties and heat treatment of Zr–U alloys, 18: 20449 (BMI-973(Del.))
MANNSFELD, S.-P., Reaction mechanism of Diels-Alder reaction, 18: 20088
MANSON-HING, L. R., X radiation in dental offices. III., 18: 20261
MARCHAL, Raymond Hippolyte Firmin, Improvements in fuel elements, 18: 21626
MARCHATERRE, J., Two-phase flow program at ANL, 18: 20170 (TID-7694(p.11-17))
MARCHERTAS, Algirdas Henry, Deformation of a nuclear reactor grid structure, 18: 21581
MARCOVICH, H., Effects on genetic recombination of *E. coli* K-12 produced by x-ray and α-particle irradiation of the female, 18: 19620
MARGOSHES, Marvin, Emission spectrometry, 18: 19863
MARGRAVE, John L., Thermodynamic properties of inorganic substances. VII., 18: 19955
MARGULIES, S., Broadening of Mossbauer line for Gaussian spectra, 18: 21315
MARHOL, M., Ion exchangers containing P or As. I., 18: 19838 (UJV-909/63)
MARIANI, F., Intense artificial radioactivity in autumn 1962, 18: 21082
MARIN, G., Cell-killing by incorporated ^{3}H-thymidine and ^{3}H-uridine, 18: 19645
MARIN, G., HeLa S-3 cells after incorporation of ^{3}H-thymidine or ^{3}H-uridine, 18: 19644
MARINESCU, C., Serotonin in pathogeny of hemorrhagic syndrome in radiation sickness, 18: 19696
MARINOV, M. S., Interaction between particles with spins and Regge poles, 18: 20988
MARINSKY, J. A., Self-exchange measurements in a chelating ion-exchange resin, 18: 19972
MARKEZICK, Anthony R., Radiation-induced graft polymers of cotton, 18: 20084
MARKHAM, J. J., Prog. rpt. on magnetic properties of insulators, 11/16/63–2/15/64, 18: 21705 (IITRI-1184-12)
MARKOWITZ, David, Critical temperature of anisotropic superconductors, 18: 21116
MARKUS, Beno, Developments for dosimetry of fast electrons. I., 18: 19811
MARLOW, Wayland Clinton, III, Electric polarizability of atomic H, 18: 20774
MARSCHALL, H., Influence of shell structure of nucleus on spectra of μ-mesic atoms, 18: 21331
MARSH, W. R., Radiation chemistry of hydrocarbons. X., 18: 20055
MARSHAK, R. E., Group symmetries with R invariance, 18: 20995
MARSHALEK, E. R., Collective model of atomic nuclei, 18: 21189 (KR-64(Sect. VI))
MARSHALEK, E. R., Developments in collective model, 18: 21191 (KR-64(Sect. VIII))
MARSHALL, L., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
MARSICANIN, B. S., Study of r-f discharge in a single-turn coil, 18: 21514
MARTIN, A., Behavior of the partial-wave amplitudes, 18: 21036
MARTIN, F. S., Fabrication of fueled BeO, 18: 20497
MARTIN, F. S., Preparation of ceramic-grade BeO, 18: 20503
MARTIN, H., Mass effect in ion migration in solutions, 18: 20112
MARTIN, H. J., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
MARTIN, J. H., Prog. rpt. on health and safety, annual, 1963, 18: 20236 (PG-Report-565)
MARTIN, Michel Bernard, Polarization-direction correlation of As-77 γ rays, 18: 21351
MARTIN, R., Mechanical problems in gas–graphite reactors. III. Pressure vessel, 18: 21576
MARTIN, R., Mechanical problems in gas–graphite reactors. IV. Graphite stack, 18: 21577
MARTIN, R., Mechanical problems in gas–graphite reactors. VII. Fuel handling, 18: 21578
MARTIN, R., Mechanical problems in gas–graphite reactors. IX. Control rods, 18: 21579
MARTIN, R., Mechanical problems in gas–graphite reactors. VI. Gas-flow direction, 18: 21611
MARTIN, R., Mechanical problems in gas–graphite reactors. V. Fuel elements and jackets, 18: 21618
MARTIN, R., Mechanical problems encountered in gas–graphite reactors. II. General structure, 18: 21646
MARTIN, S. B., Radical yields in irradiated aromatics, 18: 20042 (USNRDL-TR-718)
MARTINI, W. R., Internal flame-heated thermionic converters, 18: 20886
MARUKYAN, T. H., Phagocytic activity of leukocytes of immunized rabbits due to radiation, 18: 19736
MARUKYAN, T. H., Radiation effects on formation of antibodies in combined administration of various antigens, 18: 19735
MARX, G., Are there two neutrinos or only one? 18: 20919
MARX, G., Transference numbers in electrolyte solutions, 18: 20010
MASHKEVICH, V. S., Stationary radiation of homogeneous system in multimode resonator. I., 18: 20310
MASON, E. A., Quantum effects in small-angle molecular-beam scattering, 18: 20736
MASUDA, Akimasa, Consequences from Pb isotopes in nature, 18: 20226 (INSJ-67)
MATHE, G., Treatment of acute total-body irradiation injury in man, 18: 19763
MATHUR, R. S., Cytochemistry of x-irradiated spermatogenesis of *Stenobothrus viridulus*, 18: 19615
MATHUR, V. K., Complex formation between U and thiomalic acid, 18: 19947
MATOLICH, J., Jr., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
MATRICON, J., Coherence length and penetration depth of dirty superconductors, 18: 21105
MATSAKOVA, A. A., Critical magnetic fields of superconducting Nb films, 18: 21114
MATSUDA, Kazuhisa, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
MATSUI, Kunio, Effect of x irradiation on Zn-65 metabolism in liver of mice, 18: 19531
MATSUNOBU, Hiroyuki, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
MATSUURA, Motohiro, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979
MATTHEWS, C. M. E., Radiation effects on survival of skin homografts, 18: 19605
MATTHIAS, B. T., Superconductivity, 18: 21106
MATURI, Vincent F., Cell for determining extractables in irradiated mate-

rials, 18: 19889
MATYASOVA, J., Effect of low radiation doses on the release of deoxyribopolynucleotides in tissues, 18: 19630
MAXIE, E. C., Cobalt-60 γ irradiator, 18: 20419
MAXUM, Bernard Harold John, Cyclotron wave instabilities, 18: 21446
MAYER, L., Investigation of hfs interactions in $Hf(NH_4)_3F_8$ crystals, 18: 21321
MAYER, R. M., X-ray diffraction studies of irradiated BeO, 18: 20608
MAYINGER, F., Burnout measurements, 18: 20180 (TID-7694(p.87-8))
MAYKUTH, D. J., Prog. rpt. on W-base sheet alloy, 5/8–8/8/63, 18: 20443 (AD-416199)
MAZEAU, J., Formation of disruptive discharge in gas, 18: 21494
MAZING, M. A., Broadening of spectral lines in a strongly ionized plasma. III., 18: 21409
MAZING, M. A., Spectral line intensity variations in toroidal discharge, 18: 21435
MAZOKHINA, N. N., Microflora of γ-irradiated products, 18: 19558 (JPRS-24187)
MAZZARELLA, L., Solid-state polymerization of trioxane, 18: 20032
MC ANDREWS, J. I., Radical yields in irradiated aromatics, 18: 20042 (USNRDL-TR-718)
MC ARTHUR, Richard D., Contained nuclear detonations in four media, 18: 20122 (UCRL-7711)
MC BETH, R. L., First observation of solution of Li,Bi, 18: 19978
MC CARDLE, Robert J., Use of Tc-99m as pertechnetate for thyroid liver and brain scanning, 18: 19814 (CONF-453-1)
MC CLELLAN, R. O., Calcium–Sr discrimination in miniature pigs, 18: 19539
MC CONNELL, William John, Electron-slowing-down spectrum in Cu, 18: 20732
MC CORMICK, Norman J., Transport solution of one-speed slab albedo problem, 18: 21134 (TID-20540)
MC COY, H. E., Jr., Mechanical properties of refractory metals, 18: 20456 (ORNL-3593)
MC CULLEN, J. D., Spectroscopy in the nuclear $1f_{7/2}$ shell, 18: 21275
MC CULLOCH, E. A., Repair in irradiated mouse hematopoietic tissue, 18: 19761
MC CURDY, W. H., Jr., Volumetric and gravimetric analytical methods for inorganic compounds, 18: 19865
MC DIARMID, I. B., Boundary of the outer radiation zone, 18: 21071
MC FEE, Alfred Frank, Testicular morphology and reproductive capacity of male rabbits following pre-pubertal irradiation, 18: 19755
MC GARVEY, F. X., Ion exchange, 18: 19859
MC GERVEY, J. D., Detection of pulse pile ups with tunnel diodes, 18: 20296
MC GLINN, W. D., Combining interaction symmetries and relativistic invariance, 18: 21052
MC GONIGAL, P. J., Centrifugal plasma jet furnace, 18: 20157
MC GOWAN, F. K., Coulomb excitation of Cu-63 and Cu-65, 18: 21281
MC GUIRE, J. B., Study of exactly soluble one-dimensional N-body problems, 18: 20923
MC HENRY, W. Dennis, Liquid scintillation technique for tool-wear determination, 18: 20426
MC INTYRE, K. G., Angular correlations for $C^{13}(p,p'\gamma)C^{13}$ in resonance-free region, 18: 21254
MC MILLAN, M., Vertex renormalization in potential theory, 18: 21038
MC PHERSON, D. A., Program to determine plasma density from H spectral line shapes, 18: 21369 (ATN-64(9233)-8)
MC QUEEN, Robert G., Behavior of metals under dynamic loading, 18: 20454 (LADC-5561)
MC SHEEHY, T. W., Dose rate and induction of mutation in Drosophila, 18: 19646
MC SHERRY, Wilbur F., Radiation-induced graft polymers of cotton, 18: 20084
MC SWEENEY, Daniel J., Pregnancy after radiation therapy, 18: 19565
MEAD, Gilbert D., High-resolution γ spectrometry, 18: 20342 (UCRL-10781)
MEDJEDOVIC, M., Uranium in the urine of miners, 18: 20271
MEE, Lona K., Effect of x rays, etc., on kinetic parameters of chymotrypsin, 18: 19666
MEEK, J. M., Absorption of photons from gas discharge, 18: 21474
MEHLHORN, W., Geiger counter with post-acceleration, 18: 20361
MEHTA, C. L., Phase-space formulation of dynamics of canonical variables, 18: 21031
MEIMAN, N. N., Asymptotic equality of differential cross sections for particles and antiparticles, 18: 21333
MEINKE, W. W., Neutrons for small laboratories, 18: 21139
MELA, R. L., Flow-balancing device for BWR, 18: 21573 (NYO-10475)
MELCHING, Hans-Joachim, Effects of serotonine on fertility of irradiated mice, 18: 19711
MELE, Aldo, Radiochemical polymerization of phenylacetylene, 18: 20052
MELLON, M. G., Light absorption spectrometry, 18: 19860
MELMAN, E., Krypton-85 uptake of the human brain, 18: 19522
MELTON, Charles E., Techniques for ion-molecule reactions studies in mass spectrometer, 18: 21703 (CONF-296-4)
MENDELSON, M. R., One-speed neutron transport in adjacent half-spaces, 18: 21140
MENDELSON, M. R., One-speed neutron transport in adjacent half spaces, 18: 21133 (TID-20503)
MENDELSON, M. R., Transport solution of one-speed slab albedo problem, 18: 21134 (TID-20540)
MENDELSSOHN, K., Appearance of friction in superfluid He, 18: 20799
MENGE, E. E., Nuclear properties of Re, 18: 21205 (NP-13807)
MENZEL, D. W., Observations in Sargasso Sea off Bermuda, 1960–1963, 18: 21711 (NYO-3140-1B)
MENZEL, Donald H., Generalized radial integrals with hydrogenic functions, 18: 21051
MERIWETHER, J. R., Scattering of 65-Mev He ions from O-16, 18: 21260
MERRA, S. G., Development of solar thermionic converters, 18: 20879
MERRIAM, M. F., Volume expansion and coloration in x-irradiated NaCl, 18: 20598
MERRITT, Lynne L., Jr., X-ray diffraction, 18: 19866
MERTE, Herman, Jr., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
MERTE, Herman, Jr., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
MESCHKOWSKI, Herbert, Hilbert space with nuclear functions, 18: 21341
MESHCHERYAKOV, M. G., pp-Phase shifts at 657 Mev, 18: 20992
MESHKOV, S., S-wave hyperon-nucleon interactions and SU, symmetry, 18: 20913 (TID-20483)
METCALFE, A. G., Emittance measurements of refractory oxide coatings, 18: 20565
MEWE, R., Measuring time resolved electron density and ion temperature of plasmas, 18: 21384 (NP-13853)
MEYER, George E., Beryllium ingot sheet, 18: 20496
MEYER, L., Internal pair production by neutron reactions in Cl-35, 18: 21236
MEYER, L. M., Fate of H^3-thymidine-labeled bone-marrow cells in irradiated recipients, 18: 19769
MEYER, Leo M., Autologous bone-marrow transfusion following chemotherapy, 18: 19768
MEYER, Lothar, Energy-transfer phenomena in liquid He, 18: 20756
MEYER, M. A., Use of ferrite memory cores, 18: 20371
MEYERAND, R. G., Jr., Fluctuations in a gyro-dominated plasma, 18: 21506
MEYERAND, R. G., Jr., Gas breakdown at optical frequencies, 18: 21513
MEYERAND, Russell G., Jr., Collision cross section of electrons with Cs atoms, 18: 20773
MEYERSON, Seymour, Mass spectra, radiolysis, and photolysis of phenyl alkyl ketones, 18: 20063
MIALKI, W., Burnout problem of liquid metals at high temperatures, 18: 20193
MICAUD, G., Heat conduction by nuclear graphite, 18: 20539
MICHAEL, James Allen, Ionization cross section of Cs near threshold, 18: 20779
MICHAEL, Paul, Transient phenomena in thermalization. II., 18: 21143
MICHAELIS, E. G., Construction of spark chamber with transparent metal mesh, 18: 20370
MICHEL, Louis, Particle polarization in high-energy physics, 18: 20893 (AFOSR-5287)
MICHEL, M., Phase systems Y–Nd and Sc–Nd, 18: 20520 (IS-841)
MICHEL, R., Containment of Fermi reactor plug, 18: 21641(NP-13793)
MICKEY, W. V., Seismic data summary, nuclear detonation program, 1961–63, 18: 20201 (NP-13867)

MIESSNER, H., Studies of electron scattering with thin foils, 18: 20670
MIETTINEN, J. K., Strontium-90 and Cs-137 in plants and animals in Lapland, 18: 20213
MIGEON, Claude J., Stability of tritium label in 1,2-H^3-D-aldosterone, 18: 19543
MIGNOT, C., Tridimensional theory of heterogeneous reactors, 18: 21560
MIKELL, R. J., FIRED—(integer data relative read), 18: 20439 (NAA-SR-Memo-9683)
MIKHAILOV, I. N., Calculations of properties of rare earths, 18: 21179 (JINR-P-1573)
MIKHAILOVA, T. G., Effect of γ radiation on dielectric properties of cable materials, 18: 20589
MIKHAILOVSKII, V. I., Telemetry of radioactive emissions, 18: 20225
MIKUMO, Takashi, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
MILCH, Robert Austin, Infrared spectra of deuterated gelatin sols, 18: 19982
MILETIC, B., Effect of repeated x irradiation on degradation of DNA, 18: 19656
MILETIC, B., Effect of x irradiation on degradation of DNA in *E. coli*, 18: 19641
MILETIC, Branimir, Restoration of viability of x-irradiated L-strain cells, 18: 19783
MILLER, Albert, Radiochemical fallout study of a Pacific cyclonic storm, 18: 20215
MILLER, C. E., Cancer hazards of exposure to radioactive isotopes, 18: 19597
MILLER, Carl F., Plant uptake of radioelements from soil, 18: 19515 (NP-13796)
MILLER, D., Measurement of neutron-proton polarization at 126 Mev, 18: 20934
MILLER, D. G., Triple-scattering parameter D_t in the free n-p system at 170°, 18: 20933
MILLER, Donald H., Existence of Kr resonant state at 726 Mev, 18: 20918 (UCRL-10797)
MILLER, F. J., Voltammetry of Ce(IV), Mn(VII), Cr(VI), and V(V), 18: 19967
MILLER, Frank L., Absolute electron excitation cross sections of He, 18: 20752
MILLER, G. L., Beam profile indicator with solid state detectors, 18: 20327 (BNL-7880)
MILLER, Harry Galen, Radioactive decay of Tb-151 and Tb-152, 18: 21348
MILLER, Helen M., Bibliography on chemical detectors, 18: 19847 (LAMS-2378(Vol.II))
MILLER, R. G., Mass of Ni-56, 18: 21357
MILLER, R. G., Model for study of neutron effects on tumors, 18: 19816
MILLER, William C., Exploding galaxy M82, 18: 20718
MILLIN, J. C. B., Radium in treatment of uterine cancer, 18: 19830
MILLS, R. M., Calculating and contouring relative power and fuel element exposure for HNPF, 18: 21640 (NAA-SR-Memo-9391)
MILTON, J. C. D., Fission experiments, 18: 21197 (KR-64(Sect.XVIII))
MILTON, J. C. D., Introduction to fission physics, 18: 21186 (KR-64(Sect.II))
MILTON, J. C. D., Theories on fission, 18: 21194 (KR-64(Sect.XV))
MINEEV, D. A., Correlation between lanthanides in ores, 18: 20227
MISHRA, A. K., Mutation frequencies of uv-irradiated *Aspergillus*, 18: 19724
MISKEL, John A., Radioactivity produced by nuclear explosives, 18: 20124 (UCRL-7761)
MITCHELL, G. R., Biological monitoring at Harwell, 1961 and 1962, 18: 20208 (AERE-R-4415)
MITCHELL, Keith James, Core supporting arrangements for reactor, 18: 21590
MITTAL, M. L., Amperometric determination of La as molybdate, 18: 19901
MIYAMOTO, Tetsu, Deformation of theta-pinched plasma, 18: 21402
MIYOSHI, Katsuhiko, Determination of O in metals by 14-Mev neutron activation, 18: 19886
MIYOSHI, Yasunori, Formation stage of spark breakdown, 18: 20146
MIZOBUCHI, Akira, Quadrupole moment of second excited state of F-19, 18: 21276
MIZUKAMI, Ikuko Fukuda, The use of A–B translocations in mutation studies, in maize, 18: 19513
MIZUSHIMA, Masatake, $\Delta S = \pm 1$ magnetic multipole radiative transitions, 18: 20751
MKRTCHYAN, R. G., Changes in proteolysis of kidneys and skeletal muscles due to radiation, 18: 19745
MKRTCHYAN, R. G., Characteristics of proteolysis of organs due to radiation lesion, 18: 19744
MOAZED, K. L., Prog. rpt. on oxide formation in initial stages of oxidation, 7/60–6/63, 18: 20468 (AROD-2734:2)
MOELLER, C., Control and instrumentation of South African Research Reactor, 18: 21686
MOHANTY, Ganesh P., Crystallographic study of $Nb_2O_5 \cdot 3WO_3$, 18: 19941
MOHR, D., Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)
MOHR, R. A., Electron bombardment heater for Na, 18: 20132 (NAA-SR-Memo-8289)
MOISEEV, S. S., Effects of finite conductivity on plasma stability, 18: 21430
MOISEEV, S. S., Turbulent diffusion of weakly ionized plasma, 18: 21425
MOISSIS, R., Flow-balancing device for BWR, 18: 21573 (NYO-10475)
MOISSIS, R., Two-phase flow studies, 18: 20173 (TID-7694(p.35-6))
MOKWA, Jozef, Spectral isotopic analysis of Pb from Polish galena deposits, 18: 20430
MOLL, J. H., High-strength, elevated-temperature, corrosion-resistant steel, 18: 20446 (ASD-TDR-63-766)
MOLL, Sheldon H., Dispersed phases in refractory metal alloys, 18: 20512 (ASD-TDR-62-7(Pt.II))
MOLLENAUER, James F. M., Data simulation with on-line computer as diagnostic and analytical tool, 18: 21158 (BNL-7836)
MONCALVO, F., Chemo-antibiotic-resistant mycobacteria subjected to x irradiation, 18: 19607
MONKS, Al, Analysis of cylindrical shell clamped along oblique contour, 18: 21733 (ORNL-tr-19)
MONKS, Al, Theoretical-numerical basis of stochastic number theory, 18: 21734 (ORNL-tr-42)
MONTANET, Lucien, High-energy nuclear interactions in cosmic radiation, 18: 21209 (NP-13842)
MONTGOMERY, D. Bruce, Superconducting magnet design, 18: 21118
MONTGOMERY, D. J., Lattice-vibration of eigenvectors and applications for NaCl and KCl, 18: 21726 (TID-20487)
MONTGOMERY, L. D., Analysis of SNAP reactor coolant cross-flow, 18: 21673 (NAA-SR-Memo-9576)
MOOLENAAR, Robert J., Production of high-purity Cs, 18: 20117
MOORE, V. S., Emittance measurements of refractory oxide coatings, 18: 20565
MOORE, William H., Jr., Responses of malignant tissue to protons, 18: 19812 (BNL-6966)
MORAN, Paul Richard, Studies of F centers in KCl, 18: 20675
MORAWITZ, Hans, $|\Delta| = \frac{1}{2}$ rule in $K^+ + \pi^+ \pi^0$ decay, 18: 21012
MORDYUK, M. S., Damping of elastic oscillations in Cu–Be and Cu–In alloys, 18: 20560
MOREAU, Claude, Preparation of UC powder, 18: 20467
MOREEN, H. A., Prog. rpt. on Nb alloy sheet rolling, 7/7/63–9/6/63, 18: 20484 (AD-418992)
MOREO, G. C., Chemo-antibiotic-resistant mycobacteria subjected to x irradiation, 18: 19607
MORGAN, A., Biological monitoring at Harwell, 1961 and 1962, 18: 20208 (AERE-R-4415)
MORGAN, A. N., Electrorefining of Pu from Pu–Fe alloys, 18: 20099 (LA-3029)
MORGAN, C. G., Ionization in He, 18: 21472
MORI, Masatake, Collisional excitation transfer between atoms, 18: 20740
MORIN, R., Visualization of nucleate boiling of water, 18: 20162 (EUR-1622.f)
MORIZE, P., Investigation of sinterable BeO powders, 18: 20505
MOROSHKINA, T. M., Simultaneous determination of Zr, Hf, Th, and Ti in ores, 18: 19912
MOROZ, A. G., Radiation effects on reproduction of parotitis virus, 18: 19556 (JPRS-23956(p.9-17))
MOROZOV, V. A., Decay scheme of Tm-164, 18: 21174 (JINR-P-1479 (p.3-25))
MORRIS, Dale D., X-ray-conditioned saccharin aversion, 18: 19667
MORRIS, T. W., Dipion mass spectra in antiproton-proton annihilations,

18: 20894 (BNL-7969)
MORRISON, George H., Extraction, 18: 20103
MORRISON, George H., Times of irradiation and decay in activation analysis, 18: 19874
MORRISON, Ian Hugh, Fuel elements for use in reactors, 18: 21627
MORRISON, R. C., Photoproton cross-section for O-16, 18: 21163 (CONF-481-4)
MORTON, K. W., Finite amplitude compression waves in collision-free plasma, 18: 21386 (NYO-10434)
MORTON, Maxwell R., Static firing of large nuclear rocket stages, 18: 21680
MOSKALEV, Yu. I., Biological effects of fast neutrons, 18: 19677
MOSSER, Donn G., High-resolution density-gradient separation of bone-marrow cells, 18: 19525
MOSZYNSKI, M., Improving the resolution of time-of-flight spectrometer, 18: 20338 (PAN-469/I)
MOTZ, H., Systematics of γ decay schemes from neutron capture, 18: 21193 (KR-64(Sect.XIV))
MOU, Shih-fan, Spectrophotometric determination of rare earth elements, 18: 19895
MOUELLIC, B., Construction of spark chamber with transparent metal mesh, 18: 20370
MOUSSEZ, Cl., Adaptation of vortex flow to biphase liquid gas mixture, 18: 20181 (TID-7694(p.89-107))
MOVSESYAN, M. A., Change of peripheral blood after bloodletting in animals suffering from radiation sickness, 18: 19732
MOWBRAY, D. F., Bending-fatigue properties of Zy-4, 18: 20521 (KAPL-3016)
MUCCINO, Angelo, Bibliography on liquid metals and applications, 18: 20444 (AD-417111)
MUEHLENKAMP, G. T., Properties and heat treatment of Zr–U alloys, 18: 20449 (BMI-973(Del.))
MUELLER, D. W., Prestressed concrete spherical containment vessel, 18: 20130 (LADC-5817)
MUELLER, J., Structure and electronic properties of Nb–Ru alloys, 18: 20557
MUELLER, Volkhard F., Low-energy πK scattering, 18: 20977
MUKHERJI, Anil K., Gravimetric determination of Zr and Hf, 18: 19871
MULLINS, J. C., Vapor pressure and heats of vaporization of CO and CO_2, 18: 19933 (NP-13862)
MULLINS, L. J., Electrorefining of Pu from Pu–Fe alloys, 18: 20099 (LA-3029)
MUNARI, Stelio, Radiolysis of 2,2,4-trimethylpentane with γ rays from Co-60, 18: 20079
MUNRO, T. R., Radiosensitivity of tumors, 18: 19606
MURAKAWA, Kiyoshi, Nuclear moments of Yb-173, 18: 21235
MURPHY, C. B., Thermal analysis, 18: 19864
MURPHY, Charles Thornton, Decay modes $\Sigma^+ \rightarrow n + e^+ + \nu$, 18: 21015
MURPHY, W. J., Centrifugal plasma jet furnace, 18: 20157
MURRAY, John L., Method of using radioactive tracers, 18: 20427
MUSHARRAF HOSSAIN, Mir, Effects of γ radiation on chromosomes of *Hymenolepis diminuta*, 18: 19752
MUSHER, Jeremy I., Magnetic shielding of nucleus by neighboring atom, 18: 21232
MUTO, Heruo, Determination of O in metals by 14-Mev neutron activation, 18: 19886
MYERS, Rollie J., Effect of Cl^- and SO_4^{-2} on paramagnetic resonance line width of Mn^{+2}, 18: 21730 (UCRL-10446)

N

NACHTIGAL, David, Immune response in immunologically suppressed animals, 18: 19722
NACU, A., 1-Mercaptopropionic acid derivatives in analytical chemistry. III., 18: 19914
NACYROV, F., Resolving power of Ar ionization chamber, 18: 20393
NAGAHARA, Yukio, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
NAGAI, Hitoshi, Composition of Sc and rare earth complexes of arsenazo, 18: 19948
NAGARAJAN, M. A., Enhancement of single-particle transition rates in C-13, 18: 21253
NAGARAJAN, M. A., Spin-orbit interactions in stripping reactions, 18: 21366
NAGASHIMA, A., Viscosity of H isotopes, 18: 19989
NAINAN, T. D., Decay of 66-min. In-110, 18: 21355
NAKAI, Kozi, Quadrupole moment of second excited state of F-19, 18: 21276
NAKAMURA, Katsuichi, Effect of slight shift of fuel elements on reactivity of UTR-B, 18: 21684
NAKANO, Yoshiei, E vs B curve hysteresis in the positive column, 18: 21403
NAKASIMA, R., Nuclear theory reference book, 1961–62, 18: 21353
NAKAYAMA, Tadayuki, Corrosion-resisting films of Ti and Zr, 18: 20481
NANDI, P., Mutation frequencies of uv-irradiated *Aspergillus*, 18: 19724
NARDELLI, G., Decay of Sn-133, 18: 21267
NARDELLI, G. C., Polarization of protons scattered from C-12, 18: 21300
NASS, H. W., Neutrons for small laboratories, 18: 21139
NATHANS, R., Itinerant electron ferromagnetism in $ZrZn_2$, 18: 20556
NATKANIEC, Ireneusz, 4π-Scintillation counter for β measurements, 18: 20380
NAUMOVA, T. N., Reaction of $AlCl_3$ with $BeCl_2$, 18: 19950
NAYDENOVA, L. P., Microflora of γ-irradiated products, 18: 19558 (JPRS-24187)
NAYLER, J. L., Conference on space technology, Hertfordshire, 3/62, 18: 20673
NAZARENKO, I. I., Valency of Re in its thiocyanate complex compound, 18: 20006
NAZAROV, N. N., Effects of γ irradiation on cotton seedlings, 18: 20418
NEDELJKOVIC, Ljubomir, Determination of moisture content of soil. I., 18: 19905
NEDOSPASOV, A. V., Ionization striations in discharge positive column, 18: 21478
NEHRKORN, Otto, Radiation injuries to hand from operational accident, 18: 19706
NEJEDLIK, James F., Test of corrosion product separator unit in Haynes Alloy No. 25 loop containing Hg, 18: 21677 (TID-20552)
NEKRASOVA, I. V., Mechanism of cystamine radiation protection, 18: 19800
NELSON, Arne, Recovery rate and dose-reduction factor in cysteamine-treated mice after irradiation, 18: 19775
NELSON, C. T., Leakage through cracks and capillaries in concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)
NELSON, Lloyd S., Use of flash heating to study combustion of liquid metal droplets, 18: 19927 (CONF-322-9)
NELSON, R. C., UO_2 fuel capability, 18: 21620
NELSON, R. S., Sputtering of metals with noble gas ions, 18: 20745
NEMODA, D., Production of Co-60 sources. I., 18: 20421
NEMODA, Dordo, Methods for preparing radioactive standards, 18: 20422
NERUDA, Josef, Radiation effect on electric charge and possibilities of use, 18: 20068
NESHPOR, V. S., Magnetic susceptibility of silicides of conducting metals, 18: 20541
NESMELOVA, E. S., Effect of γ radiation on dielectric properties of cable materials, 18: 20589
NESMEYANOVA, G. M., Effect of halide compounds on oxidation of U(IV), 18: 19943
NESTERIKHIN, Yu. E., Rayleigh-Taylor instabilities in conical plasma accelerator, 18: 21428
NESTEROV, V. M., Effect of γ radiation on dielectric properties of cable materials, 18: 20589
NESTOR, Karl, Effect of irradiated cock sperm on hatchability, 18: 19664
NEUBERT, Theodore J., Color centers and related phenomena in alkali halide type crystals, 18: 20622 (COO-1044-16)
NEUFELDT, Sieghard J., New uranates, polyuranates and polyneptunates, 18: 20012
NEUMAN, M., Calculation of continuous integrals by Monte Carlo method, 18: 21737 (UCRL-Trans-1040(L))
NEUMANN, H. G., Copolymerization of amino acids by irradiation with fast electrons, 18: 20074
NEVSHEMAL, J. A., Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)
NEWSOME, John R., Protective effects of AET and PAPP against x irradiation in dogs, 18: 19794

NEWSOME, John R., Protective effects of AET and PAPP against sublethal x irradiation in dogs, 18: 19795
NEWTON, Amos S., Excess-kinetic-energy ions in organic mass spectra, 18: 20026
NEY, P. E., Convergence of random distribution function associated with branching process, 18: 20892 (AD-434059)
NGUEN, Van Khieu, Asymptotic relations between scattering amplitudes, 18: 20907 (JINR-P-1564)
NICOL, M., Influence of high pressures on Mossbauer effect in Dy-161, 18: 21214 (UCRL-10630(Rev.))
NIEDETZKY, A., Effect of radiation on cardiac activity, 18: 19564
NIEHAUS, D. J., Electronic design approaches, 18: 20304
NIEL'SON, L. A., Preparation of Nb by reduction of $NbCl_5$, 18: 20009
NIEWIADOMSKI, Tadeusz, 4π-Scintillation counter for β measurements, 18: 20380
NIEWODNICZANSKI, Henryk, Spectral isotopic analysis of Pb from Polish galena deposits, 18: 20430
NIGAM, H. L., Complex formation between U and thiomalic acid, 18: 19947
NIGROVIC, V., Excretion of radiocesium in rats, 18: 19534
NIHOUL, J., Note on recovery in neutron-irradiated Mo and Nb, 18: 20596
NIKITINE, S., Radiation effects on Cu$_2$O absorption spectra, 18: 20077
NIKOL'SKII, B. A., Neutral K mesons, 18: 20974
NILSSON, N. R., Runaway electrons in toroidal discharges, 18: 21533
NISHIGAKI, S., Fabrication of BeO–UO_2–Be fuel pellets, 18: 20504
NISHIJIMA, Toraji, Hardness and annealing behavior of UO_2, 18: 20544
NISHIMURA, Kozoo, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
NITSCHKE, Hermann-Wolfgang, Metabolism of Pr-143 after inhalation of liquid aerosol, 18: 19544
NIWA, Tokeo, Effect of slight shift of fuel elements on reactivity of UTR-B, 18: 21684
NIZELSKII, Y. N., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
NOBIKOV, D. L., Ion source for 1-Mev photon accelerator, 18: 20691
NOER, Richard Juel, NMR in superconducting V films, 18: 21117
NOETHEL, H., Influence of x rays on vitality of *Drosophila melanogaster*, 18: 19750
NOKAY, Naime, Abscopal effects and bone-marrow repopulation in man and mouse, 18: 19592
NOLLE, H., Effect of radiation-induced lattice growth on strength of BeO, 18: 20606
NONAKA, Isaru, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
NORDHAGEN, R., Decomposing γ spectra and determining spins of levels, 18: 21202 (KR-64(Sect.XXXII))
NORDLING, Carl, Electron binding energies in Th, 18: 20767
NORTHCOTT, J. A., Dust prevention in nuclear materials mines, 18: 20270
NORTON, M. T., Prog. rpt. on cryogenic magnetic refrigeration, 2/64, 18: 21095 (NBS-8239)
NOSSAL, Ralph J., Irreversible statistical mechanics of moderately dense fluids, 18: 20633 (TID-20512)
NOTTINGHAM, W. B., Ion drag of electrons, 18: 20845
NOTTINGHAM, W. B., Voltage-current data, 18: 20844
NOVAK, Dj., Effect of repeated x irradiation on degradation of DNA, 18: 19656
NOVICK, R., Prog. rpt. on useful range of EM spectrum, 9/16–12/15/63, 18: 20627 (NP-13815)
NOVIKOV, A. I., Coprecipitation of Pu with $Fe(OH)_3$, 18: 19915
NOVOSELOVA, A. V., Reaction of AlCl$_3$ with $BeCl_2$, 18: 19950
NOWELL, Peter C., Chromosome changes following irradiation in mammals, 18: 19583
NOYES, R. C., Design of SRE-PEP core III variable orifice, 18: 21572 (NAA-SR-Memo-9253)
NURUSHEV, S. B., Polarization investigation in proton scattering at high energy, 18: 20383
NURUSHEV, S. B., pp-Phase shifts at 657 Mev, 18: 20992
NUSSBAUMER, D. A., Regulatory control program for U milling, 18: 20272
NYBAKKEN, T. W., Low-energy γ spectroscopy, 18: 20373
NYBORG, P., Approximate relativistic equations of motion, 18: 20646
NYGAARD, Keare J., Townsend discharges in H, 18: 21473
NYYSSOENEN, Otto, Radiation effects on epidermal hyperplasia in mice. VI., 18: 19704

O

OBAYASHI, Tetsuzo, Electrical state of the upper atmosphere, 18: 21078
OBERHOFER, Martin, Radiation protection practice. II., 18: 20275
O'CONNELL, J. S., Photoproton cross-section for O-16, 18: 21163 (CONF-481-4)
ODA, Nakaaki, Determination of impurities in Ta by d-c arc method, 18: 19894
ODEN, Lynn, Quantum cell model for hard spheres, 18: 21053
OEBELIEU, Rene George Julien, Improvements in fuel elements, 18: 21626
OECHSNER, H., Mass dependence of sputtering at low bombarding energies, 18: 20786
OERLEIN, Karl F., Radiological emergency procedures, 18: 20273
OFER, S., 26.8-Kev state of I-129, 18: 21238
OGARD, A. E., Thermal expansion of PuC and UC–PuC solid solution, 18: 20522
OGATA, H., Nuclear theory reference book, 1961–62, 18: 21353
OGAZA, S., Magnetic interaction excited state of Gd-155 with electronic shell, 18: 21211 (PAN-299)
OGDEN, H. R., Prog. rpt. on W-base sheet alloy, 5/8–8/8/63, 18: 20443 (AD-416199)
OGIEVETSKII, V. I., Does there exist a world of very strange nuclei?, 18: 21184 (JINR-P-1583)
OGIEVETSKII, V. I., Minimal interactions between spin 0, ½, and 1 fields, 18: 21064
OGILVIE, Robert E., Dispersed phases in refractory metal alloys, 18: 20512 (ASD-TDR-62-7(Pt.II))
OGURTANI, T. O., Motional narrowing of NMR lines in LiF, 18: 19991
OH, S. K., Linearized magnetogasdynamics, 18: 20677
OHARA, Sachiko, Compound lipids from x-irradiated animals. II., 18: 19561
OHNISHI, Haruyuki, Deformation of theta-pinched plasma, 18: 21402
OHNUMA, S., Choice of primary proton energy for meson factory, 18: 21213 (TID-20440)
OHNUMA, S., Quadrupole focusing in proton linear accelerator, 18: 20681 (TID-20457)
OJEMANN, Robert G., Scanning with positron-emitting radioisotopes, 18: 19817
OKA, Yoshinaga, Determination of Zr with flavonol-2'-sulfonic acid, 18: 19884
OKADA, M., Studies on activation analysis. I., 18: 19906
OKAI, Bin, Superconducting current capacities of Nb–Zr alloys, 18: 21098
OKAMOTO, Toshio, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)
OKSMAN, Yu. A., Observation of effects of light and field on semiconductors, 18: 20307
OLDFIELD, B., Preparation of ceramic-grade BeO, 18: 20503
OLIN, Tord, Flash roentgen tubes, 18: 20308
OLMSTED, John, III., Excess-kinetic-energy ions in organic mass spectra, 18: 20026
OLSHANSKAYA, N. I., Effect of γ radiation on dielectric properties of cable materials, 18: 20589
OLSSON, M., Reactions $\pi + N \rightarrow \pi_1 + \pi_2 + N'$ from threshold to 700 Mev, 18: 20915 (TID-20490)
OM, Son Kho, Wave propagation in structural waveguide, 18: 20623 (JINR-P-1565)
O'MALLEY, Thomas F., Improved minimum principle for multichannel scattering, 18: 21050
OMAN, Robert Milton, Work function and adsorption properties of Nb, 18: 20564
ONEGA, R. J., Decay of Xe-137, 18: 21361
ONISHCHENKO, I. N., Motion of dense plasma clusters in toroidal solenoid magnetic field, 18: 21437
ONISHCHENKO, L. M., Ion source for 1-Mev photon accelerator, 18: 20691
ONISHI, Hiroshi, Composition of Sc and rare earth complexes of arsenazo, 18: 19948
ONUCHIN, A. P., Errors in experiments on coincidence beams, 18: 20382
ONUMA, Naoki, Anion-exchange behavior of Sc in chloride-thiocyanate media, 18: 20113
OPHEL, T. R., Low-lying levels of Al-27. I., 18: 21256
OPOWER, Hans, Mass spectrograph for analysis of fission-product beams, 18: 20311

OPOWER, Hans, Mass spectrographic separation of ion beams fission of U-235, 18: 20312
OPPEN, Walter R., Asymmetrical a-c thermionics, 18: 20888
OPPENHEIM, A. K., Pressure wave generated in fissionable gas by neutron irradiation, 18: 21268
OSBORNE, James W., Mucosal uptake of Fe-59 by intestine-irradiated rats, 18: 19787
OSTERBERG, Charles, Radioactive particle in sediment from the Columbia River, 18: 20219
OSTROWSKI, Kazimierz W., Sources of instability of work of G-M end window counters, 18: 20381
OSZYWA, Z., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
OTROSHCHENKO, G. A., Pulsed source of tritium ions, 18: 20654
OTSTAVNOV, P. S., Fluxes of fast- and moderated neutrons in localities, 18: 21137
OTSTAVNOV, P. S., High-efficiency He scintillation detector for neutrons, 18: 20398
OVCHARENKO, O. N., Critical magnetic fields of superconducting Nb films, 18: 21114
OVCHINNIKOV, E. P., Accelerating cycle in circular phasotron, 18: 20685
OVERMAN, R. R., Protective effects of AET and PAPP against x irradiation in dogs, 18: 19794
OVERMAN, R. R., Protective effects of AET and PAPP against sublethal x irradiation in dogs, 18: 19795
OVSYANNIKOVA, L. P., Achromatic quadrupole lenses, 18: 20686
OWEN, W. D., Cathode electron emission and vacuum breakdown, 18: 20139
OWEN, W. L., Radiological recovery of land target components, 18: 20237 (USNRDL-TR-700)
OWENS, Albert H., Jr., Effects of cytotoxic agents on antibody production in man, 18: 19523
OXLEY, A. J., Octal-decimal converter and adding machine, 18: 20301

P

PAAKKOLA, O., Strontium-90 and Cs-137 in plants and animals in Lapland, 18: 20213
PABST, Hans Werner, Influence of partial-body irradiation on liver functions, 18: 19720
PADILLA, Andrew, Jr., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
PADILLA, Andrew, Jr., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
PAGE, E. M., Control of fast reactors, 18: 21561 (APEX-603(Del.))
PAI, S. I., Linearized magnetogasdynamics, 18: 20677
PAIC, M., Discrimination of protons and α particles in emulsions, 18: 20362
PAIC, V., Discrimination of protons and α particles in emulsions, 18: 20362
PAIS, A., Approximate unitary symmetry and the parity question, 18: 20955
PALEVSKY, Harry, Use of cold neutrons in solid state research, 18: 21121 (BNL-7958)
PALFREYMAN, Michael, Process for the preparation of carbide, 18: 20508
PALIOBAGIS, Marko A., Chemistry of poly(vinyl chloride) stabilization. III., 18: 20028
PALIOBAGIS, Marko A., Chemistry of poly(vinyl chloride) stabilization. IV., 18: 20029
PALIOBAGIS, Marko A., Chemistry of poly(vinyl chloride) stabilization. V., 18: 20030
PALMEDO, P. F., Refined structure within UO_3 clusters, 18: 21612 (CEA-2387)
PALMER, A. R., Diffusion of tritium from irradiated BeO powders, 18: 20613
PALMER, A. R., Release of Xe-133 on heating of UO_3–ThO_3–BeO, 18: 20572
PALMER, H. E., Radioactivity in northern Alaskan eskimos and their foods, 18: 20231 (HW-SA-3048)
PANDARESE, F., Behavior of tunnel diode amplitude discriminators, 18: 20291
PANKRATOV, V. M., Cross section of T(d,n)^{4}He and D(d,n)^{3}He, 18: 21218
PANOV, D., Uranium in the urine of miners, 18: 20271
PAOLETTI, A., Proper use of the polarized neutron spectrometer, 18: 20368
PAOLINI, F. A., Chemo-antibiotic-resistant mycobacteria subjected to x irradiation, 18: 19607
PAPPAS, A. C., Delayed neutrons in fission, 18: 21196 (KR-64(Sect. XVII))
PAPPAS, A. C., Distribution of nuclear charge in fission, 18: 21195 (KR-64(Sect.XVI))
PAREISHVILI, E. A., Changes of blood cells and hemopoietic system due to x irradiation, 18: 19730
PAREISHVILI, E. A., Changes in blood and hemopoietic system shortly after castration due to x irradiation, 18: 19731
PAREISHVILI, E. A., Influence of decortication on hemopoiesis of irradiated dogs, 18: 19733
PAREZANOVIC, P., Determination of hydrocarbon content. III., 18: 19904
PARKER, D. G., Geophysical effects of 1962 U.S. HA nuclear tests, 18: 21085
PARKER, E. N., The solar wind, 18: 20717
PARKER, F. L., Fate of radionuclides released to surface stream, 18: 21697
PARKER, W., Electrodeposition of Th and U, 18: 20494
PARKER, W., Electrodeposition of rare-earth elements, 18: 20495
PARKINSON, T. F., Nuclear properties of Re, 18: 21205 (NP-13807)
PARKS, D. E., Neutron thermalization in graphite, 18: 21146
PARLETT, Beresford, Convergence of QR algorithm, 18: 21713 (NYO-10437)
PASHKEVICH, V. V., Excited states of non-axial odd-mass atomic nuclei, 18: 21180 (JINR-P-1574)
PASHKEVICH, V. V., Multiple Coulomb excitation of rotational states of even-even atomic nucleus, 18: 21177 (JINR-P-1563)
PASHOS, T. J., UO_2 fuel capability, 18: 21620
PASKIN, Arthur, Surface superconductivity in type I and type II semiconductors, 18: 21101
PASTUSKA, G., Thin-layer electrophoresis application to separation of phenols and phenolic acids, 18: 21736 (SC-T-64-615)
PATEL, P. M., Measurement of neutron-proton polarization at 126 Mev, 18: 20934
PATRICK, H., Effect of irradiated cock sperm on hatchability, 18: 19664
PATT, H. M., Cell proliferation in bone marrow, 18: 19509
PAULY, H., Calculations of resonance behavior of scattering cross section for atomic collisions. II., 18: 20765
PAVLICHENKO, O. S., Microwave emission in an electrodeless induction discharge, 18: 21394
PAVLOTSKII, I. P., Self-consistent potential for low-temperature plasma, 18: 21423
PAVLOVA, M., Valency of Re in thiocyanate complex, 18: 20004
PAVLOVA, N. P., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
PAVLYUK, R. A., Preparation of MoS_2, 18: 20001
PEARCE, R. M., Thermal neutron spectrum in a moderator with temperature discontinuity, 18: 21145
PEARS, C. D., Emittance measurements at higher temperatures, 18: 20566
PEARSON, E. N., SRE systems and components experience for Core II, 18: 21571 (NAA-SR-Memo-9003)
PEDROCCHI, E., Isokinetic sampling probe for phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)
PEEBLES, P. J. E., Evolution of solar system and expansion of universe, 18: 20712
PEEK, James M., Inelastic scattering of electrons by the H molecule ion, 18: 20750
PEER, Janos, Blood volume changes after P-32 therapy, 18: 19661
PEKAREK, L., Pulse-disturbance in a d-c discharge plasma, 18: 21460
PELLEGRINI, F., Reaction (d,^{3}He) on S nuclei, 18: 21210 (PAN-288)
PELLETIER, Claude, Nuclear interactions at several tens of Bev in cosmic radiation, 18: 21207 (NP-13839)
PELTE, D., Angular correlation measurements in Ne-22, 18: 21246
PENG, Li, Stratospheric wind temperature and isobaric height conditions during IGY period. II., 18: 20619 (TID-20511)
PENGRA, James Gordon, Electron-capture decay of Fe-55, 18: 21347
PENKOVSKII, V. V., Effect of radiation on metals, 18: 20601
PENSKO, J., Gamma radioactivity of building materials, 18: 20210 (CLOR-20)
PERDREAUVILLE, Farrell J., Nonlinear dynamics study, 18: 21720 (SC-TM-264-63(15))

PEREGUD, B. P., Vertical focusing of electron beam with cylindrical magnetic lenses, 18: 20704
PEREGUDOV, I. G., Cortisone therapy applied to healthy and irradiated rabbits, 18: 19613
PEREY, F. G., Elastic scattering of deuterons from Ni-60 and Cd-114, 18: 21161 (CONF-417-26)
PEREZ Y JORBA, Jean-Paul, Spins and parities of excited levels, 18: 21208 (NP-13841)
PERFILEV, L. P., Integrated coincidence γ spectrometer for analysis of complex decay schemes, 18: 20386
PERKINS, D. H., Nuclear interactions from 30 to 10^4 Bev, 18: 20969
PERKINS, J. F., Energy minimum principle for Hartree-Fock calculations, 18: 20808
PERNER, D., Reaction of white P with CCl_4, 18: 20091
PEROVIC, B., Ranges and depth distribution of ions in metals, 18: 20672
PERRET, Joseph D., Jr., Distillation for recovery and characterization of high boiler, 18: 21552 (NAA-SR-Memo-7545)
PERRIN, R. M. S., Dating of humus podzols by residual radiocarbon activity, 18: 20223
PERRY, Vernon P., Collection, storage, and transfusion of peripheral blood leukocytes, 18: 19776
PERSHITS, Yu. N., Effects of foreign ions on electric conductivity of irradiated alkali halide crystals, 18: 20588
PERSIDSKY, Maxim D., Radiation protection of mice with bone marrow and spleen, 18: 19778
PESCHKA, W., Nuclear propulsion systems for space vehicles, 18: 21678
PESHKOV, V. P., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
PESHKOVA, V. M., Valency of Re during reduction, 18: 20005
PETER, Otto, Output of characteristic x rays, released by protons, from Al, 18: 20734 (UCRL-Trans-1050(L))
PETERLONGO, G., Pressure drops in steam–water mixtures, 18: 20164 (EURAEC-1004)
PETERS, B., Cosmic rays, solar particles and space research, 18: 20821
PETERSON, E. G., Shielding calculations for power reactor, 18: 21636 (HW-72844)
PETERSON, Malcolm L., War and medicine, 18: 19793
PETERSON, O. P., Cellular shifts in lymph nodes of irradiated animals vaccinated against influenza, 18: 19557 (JPRS-23956(p.18-26))
PETKOV, I. Zh., Inelastic scattering of polarized electrons on nuclei, 18: 21181 (JINR-P-1575)
PETRANYI, Gyozoe, Jr., Extracellular water space changes in intestinal radiation death, 18: 19718
PETROV, I. A., Theory of channel consisting of magnetic quadrupole lenses, 18: 20703
PETROVIC, Danilo, Restoration of viability of x-irradiated L-strain cells, 18: 19783
PETROVIC, Ljiljana, Effect of postradiation bleeding on hematopoiesis and survival. IX., 18: 19717
PETROVICH, I. K., Biological effects of fast neutrons, 18: 19677
PETROW, Henry G., Radioactivity in atmospheric effluents of power plants, 18: 20265
PETRUKHIN, V. I., Beta decay of the pion, 18: 20905 (JINR-P-1559)
PETRZHAK, K. A., Probability of ternary fission of U-235 and U-238, 18: 21219
PETRZHAK, K. A., Spontaneous fission of Cm-244 with emission of long-range α particle, 18: 21222
PETUSHKOV, A. A., Circular polarization of γ quanta emitted by atomic nuclei after β decay, 18: 21309
PEXTON, Robert L., K-shell photoelectric cross sections from 200 kev to 2 Mev, 18: 20753
PEXTON, Robert L., Polarization correlations in atomic photoeffect, 18: 20754
PFENDER, E., Generation of high-density H plasma, 18: 21496
PHAM-DINH-LIEN, Differential cross sections for $C^{13}(Li^6,\alpha)N^{15}$, 18: 21295
PHILBROOK, G. E., Chain reactions in chemiluminescent oxidation of phthalazinediones by K peroxydisulfate, 18: 21722 (TID-18810)
PHILLIPS, R., Three-phase a-c arc heater, 18: 20129 (ARL-64-29)
PHILLIPS, R. D., Bone growth deficit in x-irradiated rat, 18: 19555 (USNRDL-TR-721)
PIATTI, G., Analysis of SAP with various oxide contents, 18: 20517 (EUR-1613.i)
PICKART, S. J., Itinerant electron ferromagnetism in $ZrZn_2$, 18: 20556
PICKAVANCE, T. G., Nimrod, 18: 20694
PICKERING, R. J., Fate of radionuclides released to surface stream, 18: 21697
PIETSCHMANN, H., W-induced anomalous magnetic moment of leptons, 18: 20982
PIFER, James W., Radiation-induced thyroid carcinoma, 18: 19598
PIGNOTTI, Alberto, SU_3 octet of Regge poles implied by bootstrap dynamics, 18: 21042
PILCHER, M. L., Impulse discharges in crossed electric and magnetic fields, 18: 21501
PILLER, Siegmund, Blood form and serum protein changes for rats after whole-body irradiation, 18: 19703
PINON, Ramon, Beam design, 18: 20682 (TID-20563)
PIONTKOVSKII, I. A., Higher nervous activity of animals irradiated in the antenatal period. V., 18: 19608
PISANKO, A. I., Spectral line intensity variations in toroidal discharge, 18: 21435
PJERROU, Gerald M., Properties of Ξ hyperons, 18: 20959
PLAIN, G. L., Survival of lethally irradiated dogs, 18: 19603
PLATO, Guenther, Propagation of Alfven waves in inhomogeneous magnetic fields, 18: 20651
PLATZMAN, P. M., Fermi-liquid effects in cyclotron resonance, 18: 21047
PLAYFAIR, J. H. L., Viability of frozen and stored bone marrow, 18: 19805
PLESCA, I., Serotonin in pathogeny of hemorrhagic syndrome in radiation sickness, 18: 19696
PLOUGHE, William D., Elastic scattering of He-3 at 20 Mev , 18: 21359
PLURIEN, Pierre, Method of manufacturing porous barriers, 18: 20437
PNEUMAN, Gerald W., Hydromagnetic waves in current carrying plasma column, 18: 21385 (NP-13863)
PONOMARENKO, Yu. B., Ionization striations in discharge positive column, 18: 21478
POGOSYAN, M. O., X- and γ-radiation effects on vitamin B_{12} content in liver and kidneys of mice, 18: 19743
POLAK, L. S., Radiolysis of cyclohexane adsorbed by synthetic zeolites, 18: 20051
POLCYN, Roger F., Bivariate distribution function for plasma in magnetic field, 18: 21388 (TID-20491)
POLICHAR, R., Circular polarization of γ rays following β decay of Al-24 and Na-24, 18: 21269
POLLARD, B. R., Single pion production in π–N scattering, 18: 20964
POLLOCK, D. H., Ionization processes in Cs vapor, 18: 20853
POLLYCOVE, Myron, Beta irradiation of dog lymphatic structures, 18: 19601
POLLYCOVE, Myron, Radiation-induced hemorrhagic diathesis in dogs, 18: 19600
POLOMIK, E. E., Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
POLOTSKII, I. G., Damping of elastic oscillations in Cu–Be and Cu–In alloys, 18: 20560
POLOVIN, P. V., Kinetic instability in magnetic field, 18: 21432
POLUBARINOV, I. V., Minimal interactions between 0, ½, and 1 fields, 18: 21064
POLYAKOV, Yu. M., Preparation of Nb by reduction of $NbCl_4$, 18: 20009
PONAMARENKO, A. G., Rayleigh-Taylor instabilities in conical plasma accelerator, 18: 21428
PONTENZA, R., Spectrometers for fast neutrons, 18: 20365
PONTI, C., Comparison between codes for calculation of thermal spectra in homogeneous media, 18: 21122 (EUR-1605.e)
PONZANO, G., Nuclear direct photodisintegration, 18: 21266
POOLEY, D., Vacancy production by x rays in KI, 18: 20656
POPE, A. L., Data in Winfrith nuclear data library, 7/63, 18: 21156 (AEEW-R-351)
POPOFF, I. G., Reaction rates determined from ionospheric observations, 18: 21094
POPOV, D. K., Content of Sb-125 in soil cover and in plants, 18: 19516
POPOV, V. S., Regge poles and resonance nuclear reactions. I., 18: 21332

POPP, Diana M., Lethally irradiated F_1 hybrids, 18: 19770
POPP, Raymond A., Lethally irradiated F_1 hybrids, 18: 19770
POPPOFF, I. G., Ion kinetics in the lower ionosphere, 18: 21075
PORJES, H. S., Program to determine plasma density from H spectral line shapes, 18: 21369 (ATN-64(9233)-8)
PORTEOUS, D. D., Fasted mouse in the study of bone-marrow stem-cell kinetics, 18: 19636
PORTEOUS, D. D., Stem-cell kinetics after irradiation, 18: 19635
PORTER, Charles R., Subthermal neutron beam collimated by total reflection, 18: 21120 (AMRA-TR-63-25)
POSKANZER, A. M., Excitation function for $C^{13}(\pi^-,\pi^-n)C^{12}$, 18: 21293
POSTMA, H., Beta decay after capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
POSTMA, H., Experiments with polarized nuclei and polarized neutrons, 18: 21127 (KR-64(Sect.XXV))
POSTMA, H., Filters, shielding, and targets, 18: 21130 (KR-64(Sect.XXX))
POTNIS, V. R., Nuclear energy states of In-115, 18: 21289
POTTER, R. A., Thrust units for power-limited propulsion systems, 18: 20639
POVH, B., Angular correlation measurements in Ne-22, 18: 21246
PRADEL, J., Determination of filter efficiency using radioactive ions, 18: 20239 (NP-tr-1124)
PRASAD, K. G., Nuclear levels of Au-199, 18: 21243
PRASAD, Kedar N., Mucosal uptake of Fe-59 by intestine-irradiated rats, 18: 19787
PRATL, J., A-c arc movement in transverse magnetic field, 18: 21485
PRATT, R. H., K-shell photoelectric cross sections from 200 kev to 2 Mev, 18: 20753
PRATT, R. H., Polarization correlations in atomic photoeffect, 18: 20754
PREDAZZI, E., Vertex renormalization in potential theory, 18: 21038
PREGL, G., Anisotropy of diffusion constant in media with empty channels, 18: 21141
PRENSKY, Wolf, Incorporation of H^3-arginine in chromosomes, 18: 19518 (BNL-7007)
PREPARATA, G., Tests for spin and parity of the B meson, 18: 20957
PRESTON, M. A., Velocity-dependent N-N potentials and saturation in nuclear matter, 18: 21223
PRESTWICH, W. V., Decay of 92.5-min La-142, 18: 21270
PREVOT, F., Annular source of ions in crossed fields, 18: 20155
PREVOT, F., Fluctuations and rotations in a plasma column, 18: 21504
PRICE, G. H., Adsorption of water and CO_2 on BeO, 18: 20014
PRICE, G. H., High-temperature reaction between BeO and H_2O, 18: 20016
PRICE, Glenn A., Reactor physics data for enriched-U, water-moderated lattices, 18: 21594 (BNL-6975)
PRINCE, A., Nine- and sixteen-group cross sections for W, 18: 21168 (GEMP-223)
PROFIROV, Dimiter, X-ray combination injury in close irradiation of skin cancers, 18: 19714
PROKHONCHUKOV, A. A., Effects of incorporated I-131 on protometabolism in calcified tissues, 18: 19679
PROKHOROV, A. M., Excitation and ionization of atoms in strong radiation field, 18: 20770
PROKOSHKIN, Yu. D., Beta decay of the pion, 18: 20905 (JINR-P-1559)
PROPST, Franklin Moore, Ejection of electrons from W, 18: 20777
PROTTI, A. M., Comparison between steam-sintering and H sintering of UO_2 pellets, 18: 20489
PROUT, W. E., Ion exchange absorption of Cs, 18: 20097 (CONF-179-1)
PRYOR, A. W., Electrical conductivity of BeO, 18: 20576
PRYOR, A. W., Thermal vibrations in BeO, 18: 20574
PRYOR, A. W., Thermal conductivity of neutron-irradiated BeO, 18: 20611
PUESCHEL, W., Production of hyperfragments, 18: 20938
PULATOVA, E. E., Changes of blood cells and hemopoietic system due to x irradiation, 18: 19730
PULATOVA, E. E., Changes in blood and hemopoietic system shortly after castration due to x irradiation, 18: 19731
PULATOVA, E. E., Phagocytosis of glycogen content in blood cells and hemopoietic organs of irradiated animals, 18: 19734
PURDOM, C. E., Dose rate and induction of mutation in Drosophila, 18: 19646
PYLE, Hugh M., Poststorage viability of human bone marrow, 18: 19526
PYLE, Robert V., Instability of an a-c positive column, 18: 21412

Q

QUATAERT, D., Analysis of SAP with various oxide contents, 18: 20517 (EUR-1613.i)
QUINCHE, J. P., Separation of rare earths. XI., 18: 20108
QUINN, E. P., Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))

R

RABB, David D., Contained nuclear detonations in four media, 18: 20122 (UCRL-7711)
RABOTTI, Giancarlo F., Bone marrow and spleen patterns in mice irradiated and protected with homologous cells, 18: 19767
RABOTTI, Giancarlo F., Mortality of sublethally x-irradiated mice, 18: 19727
RABY, Bruce A., Preparation, properties, and uses of WO_3, 18: 19879
RADAK, Branislav, Radiation chemistry of aqueous solutions, 18: 20083
RADEKA, V., Field-effect transistor, 18: 20279 (BNL-7867)
RADFORD, Edward P., Jr., Concentrations of α-emitting elements in teeth and bones, 18: 19532
RADHA, T. K., Regge poles and resonances, 18: 20996
RADHA, T. K., Symmetries and resonances, 18: 20994
RADOVCICH, N. A., Flow-balancing device for BWR, 18: 21573 (NYO-10475)
RAETHER, H., Effect of eigen space charge of electron avalanche on its development, 18: 21490
RAFF, R. A. V., Crystalline olefin polymers. II., 18: 20034
RAHMAN, Y. E., Distributions of polymeric tetravalent Pu-239, 18: 19669
RAICEVIC, P., Uranium in the urine of miners, 18: 20271
RAINS, T. C., Variation of Cs in the ocean, 18: 20220
RAIZER, Yu. P., Delay and transformation of plasma energy expanding in vacuum, 18: 21424
RAJEWSKY, B., Radioactive contamination in photographic industry, 18: 20251
RAJU, G. R. Govinda, Absorption of photons from gas discharge, 18: 21474
RAJU, G. R. Govinda, Negative impulse breakdown of large sphere-plane gaps, 18: 20150
RAKOW, A., Measurement of r-unit in range of border rays, 18: 19825
RAKOW, A., Measurement of r-unit in energy range of conventional x-ray therapy, 18: 19826
RAMACHANDRAN, G., Determination of spin-parity of resonances, 18: 20998
RAMAN, K., Electromagnetic effects in the resonances, 18: 20999
RAMAN, K., K-meson–pion resonances, 18: 21003
RAMAN, K., Regge poles in perturbation theory, 18: 20997
RAMAN, K., Single-particle exchange model and the resonances, 18: 21000
RAMASWAMY, M. K., Excited states of even-even nuclei, 18: 21303
RAMBAUSKE, Werner, Vortex-stabilized arc plasma, 18: 21497
RAND, M. H., Thermodynamic properties across UC–UN solid solution range, 18: 19923 (AERE-M-1360)
RANDIC, M., Relationship between dose of x irradiation and urinary excretion of 5-hydroxyindoleacetic acid in rats, 18: 19626
RANDOLPH, M. L., Genetic damage as function of LET, 18: 19573
RANGANATHAN, Rajiengar, Irradiation of propionamide–acrylamide system, 18: 20094
RANKAMA, Kalervo, Progress in isotope geology, 18: 20207
RANSOM, C. J., Helical structures in r-f plasmas, 18: 21516
RASIWALA, M., Nuclear quadrupole moment of Rb-87, 18: 21314
RASMUSSEN, C. E., Measurements on a rotating plasma, 18: 21500
RASMUSSEN, J. O., Influence of high pressures on Mossbauer effect in Dy-161, 18: 21214 (UCRL-10630(Rev.))
RASOR, N. S., Emission from surfaces in Cs vapor, 18: 20862
RATHUR, M. A. J., Age of Po–Be neutrons in Dowtherm-A, 18: 21138
RATLIFF, J. L., Prog. rpt. on W-base sheet alloy, 5/8–8/8/63, 18: 20443 (AD-416199)
RAUB, Ch. J., Superconductivity of ternary beta Ti alloys, 18: 21112
RAUSCH, D. W., Prog. rpt. on oxide formation in initial stages of oxidation, 7/60–6/63, 18: 20468 (AROD-2734:2)
RAW, C. J. G., Quantum effects in small-angle molecular-beam scattering, 18: 20736

RAYMUND, M., Production of hyperfragments, 18: 20938
READ, F. H., Electron impact spectroscopy. II., 18: 20760
READ, John, Restoration of supralethally irradiated amoebae, 18: 19637
REBANE, T. K., Determination of electron-produced electrostatic potential at the nucleus, 18: 20744
REBEL, Heinigerd, Electron polarization for β decay of Bi-210 and P-32, 18: 21324
RECHNITZ, Gerry A., Kinetic aspects of analytical chemistry, 18: 19868
REDD, Bryan L., Jr., Bone changes following radiation therapy, 18: 19693
REDDI, O. S., Genetic response of Drosophila spermatozoa, 18: 19647
REDDY, K. R., Decay of Sr-83, 18: 21354
REDHEAD, P. A., Desorption of CO and O^+ from Mo surfaces, 18: 20641
REDON, D., Absolute photopeak efficiency for well-type NaI(Tl) crystal, 18: 20076
REED, James F., Determination of Zr in Ta, 18: 19920
REED, Kennard Wendell, Jr., Problem in neutron transport theory, 18: 21154
REES, D. B., Noble gas ionization by fission fragments, 18: 20860
REESE, Robert M., Mass spectrometry, 18: 19861
REEVE, K. D., Fabrication and structure of BeO-based fuels, 18: 20498
REEVE, K. D., Sintering studies on ceramic fuel materials, 18: 20483 (AAEC/E-116)
REFFNER, John A., Bleaching of Cl_3^- molecule-ion centers in KCl–Pb, 18: 20038 (COO-1044-13)
REGAL, H., Electrodeposition of rare-earth elements, 18: 20495
REICHEL, Gerhard, Radiation-protection pastes for use in weak radiotherapy, 18: 19832
REIMANN, G. A., Refractory alloys, 18: 20485 (ASD-TDR-62-670(Pt.II))
REIN, R., Isotopic exchange between o-iodoanisole and inorganic I, 18: 19964
REINES, F., Limits on solar neutrino flux and elastic scattering, 18: 20713
REINHARDT, J., Formation of disruptive discharge in gas, 18: 21494
REINHARDT, J., Mechanism of initial control of spark gap, 18: 20151
REISINGER, Joseph G., Ultra soft electronic component of environmental radiation, 18: 20341 (TID-20564)
REM, Jan, Thermodynamic functions of a plasma, 18: 21450
REMLER, Edward Antoine, Quantum Yang-Mills field, 18: 21069
REMSBERG, L. P., Excitation function for $C^{14}(\pi^-,\pi^-n)C^{13}$, 18: 21293
REMY-DEFRAIGNE, J., Studies on detoxication by perfused liver. I., 18: 19631
REMY-DEFRAIGNE, J., Studies on detoxication by perfused liver. II., 18: 19632
RENAU, Jacques, Number of density fluctuations and scattering cross section for EM waves, 18: 21420
RESTELLI, G., Silicon surface-barrier detectors, 18: 20354
REUTER, A., Serum proteins in rats after protracted irradiation, 18: 19642
REVELL, S. H., Chromatid aberrations induced by radiations, 18: 19559
REYNOLDS, C. A., Hyperfine field in Gd metal, 18: 21164 (CONF-481-36)
REYSS-BRION, M., Structures differentiated from x-irradiated amphibian ectoderm, 18: 19649
RHOADES, W. A., SNAPKIN VI—program for SNAP reactor kinetics calculations, 18: 21669 (NAA-SR-9190)
RICATEAU, P., Experimental study of an r-f Ar torch, 18: 21517
RICCI, F. P., Proper use of the polarized neutron spectrometer, 18: 20368
RICE, L. B., Neutron photoproduction cross sections of La and Pr, 18: 21278
RICE, Stuart A., Energy-transfer phenomena in liquid He, 18: 20756
RICHARDS, Paul I., Order of electron shells in ionized atoms, 18: 20758
RICHARDS, Victor, Radiation protection of mice with bone marrow and spleen, 18: 19778
RICHARDSON, J. R., Circular polarization of γ rays following β decay of Al-24 and Na-24, 18: 21269
RICHARDSON, Keith Allan, Radioactivity in Conway granite of New Hampshire, 18: 20222
RICHARDSON, Norman L., Use of flash heating to study combustion of liquid metal droplets, 18: 19927 (CONF-322-9)
RICHARDSON, R. W., Exact eigenstates of the pairing-force Hamiltonian, 18: 21034
RICHARDSON, R. W., Pairing models of Pb-206, Pb-204, and Pb-202, 18: 21239
RICHTER, Harold G., Radio-release technique for measurement of gas moisture, 18: 19848 (ORO-591)
RICHTER, J., Measurement of r-unit in energy range of conventional x-ray therapy, 18: 19826
RICHTER, Juergen, Calculation of dose distribution with digital computer, 18: 19831
RICHTER, K., Concentration dependence of separation factor of Li isotopes in ion exchange, 18: 20434
RICKEY, M. E., J dependence of angular distributions from (p,d) reactions, 18: 21299
RIDAL, A., Technique for extrusion and sintering of BeO, 18: 20499
RIDEOUT, S. P., Effects of pH on stress corrosion cracking of 18-8 stainless steel, 18: 20471 (CONF-492-2)
RIEDER, W., A-c arc movement in transverse magnetic field, 18: 21485
RIEHL, Nikolaus, Diffusion of protons (tritons) in ice crystals, 18: 20963
RIESEBERG, H., g-Factor of 155-kev 2 level of Os-188, 18: 21244
RIESS, F., 10.43-Mev state in N-14, 18: 21261
RIETHOF, T. R., Measuring normal spectral emissivity of conductive refractory compounds at high temperatures, 18: 20567
RIGBY, F., Preparation of ceramic-grade BeO, 18: 20503
RIJHSINGHANI, K. S., Oral leukoplakia after deep x-ray irradiation, 18: 19624
RILEY, Clyde, Cross sections and isomer ratios for isomeric pair Y-90g and Y-90m, 18: 21279
RINEHART, Robert R., X-ray-induced dominant lethality in oocytes of Drosophila, 18: 19622
RINGLER, H., Measurements of a stationary d-c He arc, 18: 21484
RITTENHOUSE, L. E., Vortex flow in arc heaters, 18: 21393
RITTER, George J., Hyperfine structure of level $2^2P_{1/2}$ of Li-7, 18: 21226
RIVET, E. J-M., Scattering of 65-Mev He ions from O-16, 18: 21260
ROALSVIG, J. P., Gamma–α reactions in light nuclei of emulsions, 18: 21224
ROBERTS, Arthur, Spark chamber technology, 18: 20378
ROBERTS, J. E., Hospitals code of practice, 18: 20244
ROBERTS, M. E., Plasma disturbance, 18: 21461
ROBERTS, M. J., Negative energy moments and low-energy approximations to phase shifts, 18: 21054
ROBERTS, W. H., Australian HTGCR feasibility study, 18: 21658
ROBERTS, W. T., Stacking-fault energy of some pure f.c.c. metals, 18: 20550
ROBERTSON, Harry S., Diffusion of plasmas across a magnetic field, 18: 21389 (TID-20509)
ROBERTSON, W. W., Helium afterglow. I., 18: 20737
ROBERTSON, W. W., Helium afterglow. II., 18: 20738
ROBEV, S., Nitro derivatives of monoaryl-substituted aromatic amidines, 18: 19782
ROBINSON, Berol L., Energy of the γ ray of K-40, 18: 21273
ROBINSON, C. J., Design of six digitized microscopes, 18: 20295
ROBINSON, D., Temperature measurements in a N plasma, 18: 21406
ROBINSON, M. John, Void fraction in cavitating Hg, 18: 20167 (NP-13812)
ROBINSON, R. L., Coulomb excitation of Cu-63 and Cu-65, 18: 21281
ROBSON, D., Angular correlations for $C^{12}(p,p,'\gamma)C^{12}$ in resonance-free region, 18: 21254
ROCHE, Roland, Flow-limiting devices for pressure tube assemblies, 18: 21585
ROCHE, Roland, Nuclear reactors, 18: 21589
ROESLER, Helmut, Mass spectrograph for analysis of fission-product beams, 18: 20311
ROGACHEV, V. I., Microflora of γ-irradiated products, 18: 19558 (JPRS-24187)
ROGERS, C. E., Quantum isotope effect in permeation, 18: 19961
ROGERS, D. F., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
ROHRBACH, F., Discharge mechanism in vacuum, 18: 20140
ROHRMANN, C. A., Costs for production of pure Hg-204, 18: 20429 (HW-71793)
ROHSENOW, W. M., Research in two-phase flow at M.I.T., 18: 20174 (TID-7694(p.37-41))
ROMAN, D., Diffusion of tritium from irradiated BeO powders, 18: 20613
ROMAN, Ward C., Motion of electric arcs in transverse magnetic fields, 18: 21488
ROMANI, R. J., Cobalt-60 γ irradiator, 18: 20419
ROMUSSI, M., Distribution of Bi-206 in the rat, 18: 19529
ROSA, Umberto, Improvements in methods of producing I-131, 18: 20436

ROSE, H. J., 10.43-Mev state in N-14, 18: 21261
ROSEN, Abraham, Dislocations in recovery of cold-worked Al, 18: 20533 (UCRL-10728)
ROSEN, Louis, Neutrons from interactions of 14-Mev neutrons with Li-6 ans Li-7, 18: 21263
ROSENBAUM, Fred Jerome, Cherenkov radiation from anisotropic ferrites, 18: 20775
ROSENBERG, R. L., Shocks up to infinite pressures, 18: 21728 (UCRL-7307-T)
ROSENBLATT, G. B., Jr., Solid Bi target fabrication, 18: 20486 (MTA-15)
ROSENBLUTH, Marshall N., Closed magnetic vacuum configurations, 18: 21414
ROSS, Charles P., Heavy water reactors for sea water distillation plants, 18: 21632 (DP-866)
ROSS, John S., Nuclear moments of Yb-173, 18: 21235
ROSS, Marvin, Diffusion of H and other gases in CCl_4, 18: 19963
ROSS, W. J., Activation analysis of high-purity materials, 18: 19876
ROSSI, Harold H., Radiation quality and biological effect, 18: 19570
ROSSMASSLER, W. R., Plasma torch production of elemental boron, 18: 19932 (KY-453)
ROST, E., J dependence of angular distributions from (p,d) reactions, 18: 21299
ROST, E., (p,d) Reactions on nuclei from V to Ni, 18: 21291
ROTH, John Reece, Nonadiabatic motion of charged particle in magnetic barrier, 18: 21449
ROTH, R. S., Tetragonal phases of general type $10M_2O_3 \cdot 90M_2O_5$, 18: 19942
ROTHWELL, E., Release of tritium from irradiated BeO, 18: 20612
ROUGHAN, P. E., Magnetic properties of intra-rare earth alloys, 18: 20519 (IS-551)
ROUKLOVE, Peter, Tests of set thermionic converters, 18: 20880
ROUSE, Carl A., Ionization equilibrium at high densities, 18: 20636 (UCRL-7286-T(Pt.2))
ROUX, Georges, Spectrometers using semi-conductor detectors, 18: 20330 (CEA-2388)
ROWE, G. H., Thermal expansion of TiC cermets, 18: 20513 (CNLM-4234)
ROWE, G. H., Thermal expansion of WC cermets, 18: 20514 (CNLM-4479)
ROZEN, S., Transistorized fail-safe high-low trip, 18: 20292
ROZSNYAI, B. F., Analysis of nuclear energy levels, 18: 21358
RUBBIA, C., Recent experiments with CERN synchrocyclotron, 18: 20965
RUBBINO, A., Spectrometers for fast neutrons, 18: 20365
RUBELS, A., Investigation of Hall propulsor characteristics, 18: 21391
RUDAKOV, V. P., Cross section of T(d,n) ^{4}He and D(d,n) ^{3}He, 18: 21218
RUDENKO, V. N., Dose distribution in electron-irradiated alkali halide, 18: 20043
RUDGE, M. R. H., Threshold law for ionizing collisions, 18: 20761
RUDNICK, I., Cavitation in liquid He, 18: 20678
RUDY, G. C., Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)
RUDZIT, G. P., 1-Mercaptopropionic acid derivatives in analytical chemistry. III., 18: 19914
RUELLE, David, Correlation functions of classical gases, 18: 21059
RUGGE, Henry F., Instability of an a-c positive column, 18: 21412
RUKWIED, Armin, Work hardening of neutron-irradiated Cu single crystals. I., 18: 20600
RUMFELDT, Robert C., Reactive species in irradiated liquid H halides, 18: 20062
RUMP, B. S., Power output of thermionic cells, 18: 20871
RUNCORN, S. K., Measurements of planetary electric currents, 18: 21083
RUNOLFSSON, O., Measurements of hfs, Stark effect, and Zeeman effect of $K^{39}F^{19}$, 18: 20762
RUSANOV, A. K., Analysis of solutions and silicate rocks after solution, 18: 19910
RUSSELL, E. R., Ion exchange absorption of Cs, 18: 20097 (CONF-179-1)
RUSSELL, Lewis Eric, Improvements in or relating to reactor fuels, 18: 20507
RUSSELL, R. D., Gas source mass spectrometry of trace leads, 18: 20203
RUSSO-MANDUCHI, M. T., Decay of Sn-133, 18: 21267
RUSSO-MANDUCHI, M. T., Polarization of protons scattered from C-12, 18: 21300
RUTHERFORD, J. A., Negative ions in afterglows, 18: 21093
RUZICKA, J., Substoichiometric determination of traces of metals, 18: 19852 (UJV-992/63)
RUZICKA, Jaromir, Chelating radiometric titrations, 18: 19899
RYABCHIKOV, D. I., Gravimetric determination of rare earths in rocks, minerals and alloys, 18: 19909
RYABCHIKOV, D. I., Valency of Re in its thiocyanate complex compound, 18: 20006
RYBAKOV, B. V., Cross section of T(d,n) ^{4}He and D(d,n) ^{3}He, 18: 21218
RYKALIN, V. I., Beta decay of the pion, 18: 20905 (JINR-P-1559)
RYTHER, J. H., Observations in Sargasso Sea off Bermuda, 1960–1963, 18: 21711 (NYO-3140-1B)
RZEWUSKI, Henryk, Annealing processes in Ge after radiation damage, 18: 20583 (PAN-473/II)

S

SAAKYAN, D. G., Changes of blood cells and hemopoietic system due to x irradiation, 18: 19730
SAAKYAN, D. G., Changes in blood and hemopoietic system shortly after castration due to x irradiation, 18: 19731
SAAKYAN, D. G., Phagocytosis of glycogen content in blood cells and hemopoietic organs of irradiated animals, 18: 19734
SABINE, T. M., Structure of BeO, 18: 20575
SABINE, T. M., Thermal vibrations in BeO, 18: 20574
SABINE, T. M., X-ray diffraction effects in irradiated BeO, 18: 20607
SADOKHIN, I. P., Cross sections for excitation of levels of Mg, Cr-52, Ni-58, Ni-60, and Nb-93, 18: 21217
SAENGER, Eugene L., Radiation casualties—newer aspects of mass casualty care, 18: 20258
SAFRONOV, B. G., Motion of dense plasma clusters in toroidal solenoid magnetic field, 18: 21437
SAGDEEV, R. Z., Effects of finite conductivity on plasma stability, 18: 21430
SAGGAU, B., Moving striation of low-pressure Ne discharge, 18: 21451
SAGNELL, B., Distributed multi-channel communications system for flexible remote control and telemetry, 18: 20280 (CERN-64-21)
SAILOR, V. L., Hyperfine field in Gd metal, 18: 21164 (CONF-481-36)
ST. JOHN, Daniel S., Heavy water reactors for sea water distillation plants, 18: 21632 (DP-866)
ST. JOHN, Robert M., Absolute electron excitation cross sections of He, 18: 20752
SALPETER, E. E., Multiple scattering in the diffusion approximation, 18: 20924
SALPETER, E. E., Surface x-ray emission from neutron stars, 18: 20711
SALZ, F., Fluctuations in a gyro-dominated plasma, 18: 21506
SAMADDAR, S. N., Excitation of waves in plasma, 18: 21396
SAMBELL, R. A. J., Strength of irradiated MgO, 18: 20595
SAMMET, F., Determination of Cl-36, Al-26, and Be-10 in meteorites, 18: 20221
SAMOKHIN, M. V., Transport coefficients in two-temperature plasma, 18: 21439
SAMS, Alice, Effect of x irradiation on mouse hind limb, 18: 19640
SAMSONOV, G. V., Magnetic susceptibility of silicides of conducting metals, 18: 20541
SAMSONOV, G. V., Reactive diffusion of B and C in refractory transition metals, 18: 20540
SAMUEL, David, Exchange of O-18 between H_2O and H_3PO_4, 18: 19965
SAMUELI, J. J., Nanosecond pulse generator, 18: 20300
SANDAGE, Allan R., Exploding galaxy M82, 18: 20718
SANDBORN, V. A., Study of ion production and acceleration, 18: 20289
SANDERS, J. B., Sputtering of Cu by ion bombardment, 18: 20784
SANDERSON, M. J., Compatibility of nuclear fuel and thermionic emitter materials, 18: 20876
SANDHAS, W., Quantum electrodynamics for electron-nucleon processes, 18: 21014
SANDWEISS, J., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
SANIKIDZE, D. G., Fourth sound in He^3–He^4 solution, 18: 21115
SANSOM, B. F., Concentrations of radioactive Ca, Sr, and P, in plasma of goats and cows, 18: 19541
SANTHANAM, T. S., Pion resonances, 18: 21001
SANTIROCCO, R. A., Geophysical effects of 1962 U.S. HA nuclear tests,

18: 21085
SANTOS, George W., Effects of cytotoxic agents on antibody production in man, 18: 19523
SARAZIN, A., Nanosecond pulse generator, 18: 20300
SARDARYAN, R. A., Excited states of non-axial odd-mass atomic nuclei, 18: 21180 (JINR-P-1574)
SARNECKI, S. E., Materials for mechanisms operating in 1200°F Na, 18: 20472 (NAA-SR-Memo-9340)
SARTOR, J. D., Radiological recovery of land target components, 18: 20237 (USNRDL-TR-700)
SARTOR, James D., Plant uptake of radioelements from soil, 18: 19515 (NP-13796)
SASEL, Lj., Effect of x irradiation on degradation of DNA in *E. coli*, 18: 19641
SASTRI, R. C., Influence of radial thermal gradient in Geiger counter, 18: 20404
SATAKE, Seiye, Parameters for atomic scattering, 18: 20809
SATAROV, V. I., Phase-shift analysis of N-N scattering, 18: 20904 (JINR-P-1553)
SATOW, Tsuneo, Reaction of U with graphite, 18: 19984
SATTERBLOM, P. H., $\omega-\rho$ interference, 18: 21017
SATTERTHWAITE, C. B., Superconductivity, 18: 21096 (NP-13809)
SAUER, Andrej, Higher optical distribution functions, 18: 21151
SAUZADE, M., Computation of 6th order compensated solenoids, 18: 20298
SAVAGE, D. J., Radium in treatment of uterine cancer, 18: 19830
SAVAGE, Howard F., Momentum accommodation above the sputtering threshold, 18: 20782
SAVAGE, Warren F., Weld heat-affected zone in A-212-B steel, 18: 20529 (TID-20463)
SAVERY, C. W., Analysis of multicell networks, 18: 20884
SAVVIN, S. B., Color reactions of Nb ions with certain reagents, 18: 19913
SAXENA, R. S., Amperometric determination of La as molybdate, 18: 19901
SAYERS, J., Ion and charge exchange reactions, 18: 20810
SAYERS, J. B., Behavior of fuels at high burnup. II., 18: 21619
SCALA, S. M., Aerothermochemical behavior of graphite, 18: 20525 (R63SD89)
SCARGILL, D., Decreasing extraction by processing solvents of nitrosyl-ruthenium nitrato-complexes from HNO_3 solutions. I., 18: 19924 (AERE-R-4537)
SCARSI, L., Extensive air showers, 18: 20825
SCHAEFER, Hermann J., Radiation field inside space vehicles, 18: 20240
SCHAEFFER, O. A., Temporal and spatial variation in cosmic rays, 18: 20815 (BNL-7948)
SCHATZ, Gerd, Electron polarization for β decay of Bi-210 and P-32, 18: 21324
SCHECK, F., Influence of shell structure of nucleus on spectra of U-mesic atoms, 18: 21331
SCHENCK, G. O., Dosimetry of γ radiation with ferrocenes in CCl_4, 18: 20402
SCHENCK, G. O., Reaction mechanism of Diels-Alder reaction, 18: 20088
SCHENK, G., Collapsing cylindrical metallic foils, 18: 21537
SCHIFF, L. I., Observational basis of Mach's principle, 18: 21057
SCHIFF, L. I., Theory of H-3 and He-3 form factors, 18: 21019
SCHIFFER, J. P., Elastic scattering of protons, deuterons, and α particles from Cu, Ni, and Fe, 18: 21292
SCHIRRMEISTER, Dieter, Calculation of dose distribution with digital computer, 18: 19831
SCHLEIN, Peter E., Properties of Ξ hyperons, 18: 20959
SCHLEUSS, Peter, Influence of cold treatment after irradiation on chaeta dorsocentralis anterior of Drosophila, 18: 19707
SCHLUETER, H., Helical structures in r-f plasmas, 18: 21516
SCHLUETER, J., Electron temperature and density in a θ-pinch discharge, 18: 21526
SCHMAUTZ, Eberhard, Sex dependence of distribution of Ce-144 in rats, 18: 19545
SCHMID, Albert, Tunneling current between two superconductors, 18: 21111
SCHMID, E. W., Eigenvalue of a three-body system, 18: 21048
SCHMID, L. C., Reactivity of mixed oxide fuel elements, 18: 21613 (HW-79960)
SCHMIDT, Claude H., Release of sterile males for control of *Anopheles quadrimaculatus*, 18: 19654
SCHMIDT, F. H., Proton spin flip and substate excitation in inelastic scattering, 18: 21252
SCHMIDT, L. H., Synthesis of α-DL-alanine-2-C^{14}, 18: 20033
SCHMIDT, Th., g-Factor of 155-kev 2 level of Os-188, 18: 21244
SCHMITT, B. F., Insurance of radioisotope applications, 18: 20250
SCHMITT, H. W., Fragment mass distribution for U-235 fission, 18: 21280
SCHMITT, J. M., Properties and cleanup of degraded TBP–Amsco solutions, 18: 20100 (ORNL-3524)
SCHMITZ, K., Isotopic shift in Zr-I spectra, 18: 20002
SCHMITZ, N., π^-p Interactions at 10 Bev/c, 18: 20951
SCHMORAK, M., Gyromagnetic ratio of the 4^+ state of Ce-140, 18: 21286
SCHNEIDER, H., Portable four-channel spectrometer, 18: 20347
SCHNEIDER, H., Semiconductor particle detectors. I., 18: 20349
SCHNEIDER, R. T., Spectroscopic investigation of thermionic converter, 18: 20854
SCHNITZER, Howard J., Mixing of elementary particles, 18: 20947
SCHOENEBECK, H., Theory of scattering of Li_2^+ ions on rare gases, 18: 20763
SCHOFIELD, Allen, Rare-earth distribution patterns in eight terrestrial materials, 18: 20202
SCHOLZ, W., Angular correlation measurements in Ne-22, 18: 21246
SCHOMBURG, G., Reaction mechanism of Diels-Alder reaction, 18: 20088
SCHOOLEY, J. F., Superconductivity in semiconducting $SrTiO_3$, 18: 21102
SCHOTT, L., Spatial distribution of electron temperature, 18: 21468
SCHRAMM, D. E., Multi-channel, two-dimensional, two-phase flow model for SNAP-4, 18: 21557 (NAA-SR-Memo-9444)
SCHRENK, George L., Theoretical model of thermionic converter, 18: 20848
SCHRIBER, S. O., Fictitious cascades in sum coincidence spectra, 18: 21251
SCHROMEK, Nore, Phases in system La_2O_3–CaO–ZrO_2, 18: 20538
SCHUESSLER, H., Nuclear quadrupole moment of Rb-87, 18: 21314
SCHUH, Mark W., Techniques which aid in quantitative interpretation of scan data, 18: 19835
SCHULT, O., Crystal spectrometers for measurement of neutron-capture γ rays, 18: 20333 (KR-64(Sect.XX))
SCHULTZ, L., Production cross sections for He-3 and Ne-21 from stone meteorites, 18: 20204
SCHULTZ, T. D., Quantum field theory and the many-body problem, 18: 21067
SCHULZ, G. J., Interpretation of experiments on dissociative attachment ionization of molecules, 18: 19993
SCHULZ, William D., Tensor artificial viscosity for numerical hydrodynamics, 18: 20635 (UCRL-7205-T)
SCHUMACHER, M., Light yields of organic crystals for α particles and electrons, 18: 20408
SCHUMACHER, U., Thermal energy density in confined plasmas, 18: 21532
SCHUNE-BOISBLE, D., Electrons in antinucleon annihilation stars, 18: 20928
SCHUSTER, Reinhold, Fibroblast proliferation and ^{35}S-sulfate incorporation in cornea tissue, 18: 19708
SCHWARTZ, Emanuel E., Chemical protection against radiation in tumor-bearing mice, 18: 19774
SCHWARTZ, Emanuel E., Distribution and metabolism of MEG and GED in protected mice, 18: 19772
SCHWARTZ, Emanuel E., Protein-bound protective agent in tissues of mice, 18: 19773
SCHWARTZ, R. B., Differential cross sections for triton-induced reactions on N-14, 18: 21282
SCHWARZ, A., Self-exchange measurements in a chelating ion-exchange resin, 18: 19972
SCHWARZ, Patricia, Neurospora mutants lacking ornithine transcarbamylase, 18: 19621
SCHWARZENBERG, L., Treatment of acute total-body irradiation injury in man, 18: 19763
SCHWEITZER, D. G., Oxidation rates of irradiated and annealed graphites, 18: 20580 (BNL-7964)
SCHWEITZER, Donald G., Surface superconductivity in type I and type II

superconductors, 18: 21101
SCHWINGER, Julian, Non-Abelian vector gauge fields, 18: 21050
SCIBONA, G., Influence of nitrates on HNO_3 by long-chain amines, 18: 20107
SCIUTO, F., Device for determination of purity of reactor-grade materials, 18: 20281 (EUR-523.f)
SCOTT, A., Circular polarization of γ rays following β decay of Al-24 and Na-24, 18: 21269
SCRIBNER, Bourdon F., Emission spectrometry, 18: 19863
SCROGGINS, R. M., USAEC two-phase flow program, 18: 20169 (TID-7694(p.7-10))
SEAGREN, H. E., Prog. rpt. on engineering, fabrication and field support of lab. programs, 4–9/62, 18: 21715 (ORNL-TM-791)
SEAGREN, H. E., Prog. rpt. on engineering, fabrication and field support of lab. programs, index for 4/62–9/63, 18: 21716 (ORNL-TM-794)
SEAGREN, H. E., Prog. rpt. on engineering, fabrication, and field support of lab. programs, 10/12–3/63, 18: 20134 (ORNL-TM-792)
SEATON, M. J., Threshold law for ionizing collisions, 18: 20761
SECKER, P. E., Motion of cold-cathode arcs, 18: 20144
SEGALL, Ascher, Leukemia and background radiation in Northern New England, 18: 20214
SEGALL, Ascher J., Concentrations of α-emitting elements in teeth and bones, 18: 19532
SEGRE, S. E., Breakdown in a theta-pinch apparatus, 18: 21525
SEIDL, Miles, Kinetic theory of flute instability, 18: 21371 (CLM-R-33)
SELIG, Henry, Chemistry of the noble gases, 18: 19997
SELIG, Henry, Xenon hexafluoride complexes, 18: 19999
SELLSCHAP, J. P., Nuclear structure and fundamental particles, 18: 20972
SELLYEI, M., Ultrastructure of variant of Furth mice mastocytoma, 18: 21732 (ANL-Trans-7)
SEMENENKO, K. N., Reaction of AlCl, with $BeCl_2$, 18: 19950
SEMENOV, S. S., Accelerating cycle in circular phasotron, 18: 20685
SENCHENKOV, T. M., Effect of γ irradiation on glucosamine, 18: 20049
SENGSTAKEN, Donald J., Nuclear power economics, 18: 21656
SENITZKY, I. R., Dissipation in quantum mechanics. II., 18: 21046
SENSENBRENNER, Lyle L., Effects of cytotoxic agents on antibody production in man, 18: 19523
SERENKOV, I. T., Automatic stabilization of beam of fast atomic particles, 18: 20757
SESSLER, A. M., Theory of liquid He-3, 18: 20792
SETAELAE, Kai, Radiation effects on epidermal hyperplasia in mice. VI., 18: 19704
SEUFERT, Wolfgang, Polymerization of α-methylstyrene by electron irradiation, 18: 20070
SEVASTYANENKO, V. G., Radiation cooling of gas heated by shock wave, 18: 21408
SEVY, R. H., Multigroup analysis of uniform ASCR lattices, 18: 21600 (NAA-SR-Memo-9489)
SEYERLEIN, J., Polarization and angular distribution of bremsstrahlung, 18: 21013
SHAFFER, Lawrence Bruce, X-ray scattering cross sections of liquids and solutions, 18: 20035
SHAFIEV, A. I., Counting characteristics of CO_2 detectors, 18: 20397
SHAPIRO, Bernard, Agents to protect against ionizing radiation, 18: 19791
SHAPIRO, Bernard, Chemical protection against radiation in tumor-bearing mice, 18: 19774
SHAPIRO, Bernard, Distribution and metabolism of MEG and GED in protected mice, 18: 19772
SHAPIRO, Bernard, Protein-bound protective agent in tissues of mice, 18: 19773
SHAPIRO, I. M., Method of biological dosimetry in mammals, 18: 19643
SHARIPOV, Sh., Excited states of odd nuclei with small non-axiality, 18: 21231
SHARMA, H. D., Determination of C in U and Pu carbides, 18: 19902
SHARMA, R. P., Decay of Cd-117, 18: 21288
SHARP, Brooks Martin, Solvent extraction of system rare earth nitrates–HNO_3–H_2O–TBP, 18: 20098 (IS-780)
SHATAS, R. A., Radiation damage by Compton scattering, 18: 20625 (N63-21469)
SHCHERBAKOV, Yu. A., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
SHEBEKO, A. V., Equilibrium form of light nuclei, 18: 21307
SHEINDLIN, A. E., Properties of Ar in a stabilized arc, 18: 21498
SHELDON, R., Irradiation stability of plastics and rubbers, 18: 20582 (NIRL/R/58)
SHELEPIN, L. A., Symmetry of Clebsch-Gordan coefficients, 18: 20991
SHELTON, R. D., Thrust units for power-limited propulsion systems, 18: 20639
SHEN, C. N., Nuclear reactor startup, 18: 21559
SHEN, C. S., A-c conductivity of plasma, 18: 21380 (NASA-TM-X-50732)
SHEPHARD, W. D., π^-p Interactions at 10 Bev/c, 18: 20951
SHERESHEVSKII, A. M., Magnetic-ionization manometer with high sensitivity, 18: 20198
SHERMAN, N., Exact eigenstates of the pairing-force Hamiltonian, 18: 21034
SHERMAN, N., Pairing models of Pb-206, Pb-204, and Pb-202, 18: 21239
SHERMAN, S. G., Theory of channel consisting of magnetic quadrupole lenses, 18: 20703
SHERR, R., J dependence of angular distributions from (p,d) reactions, 18: 21299
SHEWCHUCK, Sergey, Reagent and method for determining Sb, 18: 19855 (UCRL-Trans-1011(L))
SHIBANO, Hiroshi, Copolymerization of tetrafluoroethylene with ethylene, 18: 20067
SHIBATA, Shotaro, Impedance characteristics of positive column, 18: 21457
SHIDA, Yoshijiro, Decay of Eu-157, 18: 21234
SHIKLOSH, T., Energies of even-even strongly deformed nuclei, 18: 21778 (JINR-P-1568)
SHIMADA, Katsunori, Molybdenum as an emitter material, 18: 20872
SHIMIZU, Hidebumi, Effect of slight shift of fuel elements on reactivity of UTR-B, 18: 21684
SHIRANE, G., Itinerant electron ferromagnetism in $ZrZn_2$, 18: 20556
SHKODA-ULYANOV, V. A., Photoneutron yields from targets of great thickness, 18: 21308
SHOMBERT, Donald J., Semiconductor radiation detector, 18: 20417
SHORE, F. J., Hyperfine field in Gd metal, 18: 21164 (CONF-481-36)
SHRAMENKO, B. I., Photoneutron yields from targets of great thickness, 18: 21308
SHTAN', A., Radioisotopic densitometer for liquids, 18: 20320
SHUGART, T. R., Seismic data summary, nuclear detonation program, 1961–63, 18: 20201 (NP-13867)
SHUKLA, Agam Prakash, Measurement of neutron slowing-down time in water, 18: 21148
SHULL, Franklin B., Prog. rpt. on nuclear physics, final, 8/62–6/63, 18: 21157 (AFOSR-5284)
SHUTE, G. G., Angular correlations for $C^{12}(p,p'\gamma)C^{13}$ in resonance-free region, 18: 21254
SHYU, Wei-Mei, Theory of core-electron contributions to hyperfine interactions, 18: 20749
SIEGER, M., Inelastic scattering matrices for fast reactor calculations, 18: 21598 (IA-899)
SIEMSSEN, R. H., Reaction $F^{19}(d,n)Ne^{20}$, 18: 21241
SIIVOLA, A., Alpha-active isomers in Bi-201 and Bi-199, 18: 21258
SIKORA, D. I., Photoneutron yields from targets of great thickness, 18: 21308
SILBAR, Richard R., Nilsson model calculations of μ capture rates in 2s-1d nuclei, 18: 21277
SILIN, V. P., Slight damping of plasma waves, 18: 21429
SILINI, G., Model for study of neutron effects on tumors, 18: 19816
SILINI, Giovanni, Early stages of radiation recovery, 18: 19575
Silva, J. Andrade E
see Andrade E Silva, J.
SILVER, Brian L., Exchange of O-18 between H_2O and H_3PO_4, 18: 19965
SILVERMAN, Frederic N., Gonadal dosages in investigative radiography, 18: 20264
SILVESTRI, M., Two-phase flow in progress at CISE, 18: 20182 (TID-7694(p.108-49))
SIM, D. F., Regulations covering the use of ionizing radiations, 18: 20249
SIMKIN, David Alan, Field theory of electrons and phonons, 18: 21066
SIMONIN-HAUDECOEUR, C., Electrons in antinucleon annihilation stars, 18: 20928
SIMONOV, Yu. A., Regge trajectories in Bethe-Saltpeter equations, 18: 20989

SINCLAIR, Warren K., X-ray-induced heritable damage in mammalian cells, 18: 19670
SINGER, Paul, Three-pion decay modes of η- and K mesons, 18: 21021
SINGER, R. M., Oxidation rates of irradiated and annealed graphites, 18: 20580 (BNL-7964)
SINGH, N., Breakdown of gaps in electron attaching gases, 18: 20148
SINHA, B. C., Influence of β radiation on hemic elements in chronic leukemias, 18: 19789
SINNO, Renato, Behavior of clay materials passing radioactive solutions, 18: 21696
SIPPEL, Robert F., Fission damage in calcite, 18: 20224
SIRACKA, E., Possible bone injuries in telecobalt therapy, 18: 19673
SITTERSON, Beecher W., Recovery of male fertility after radiation, 18: 19648
SJOEBERG, C. Iwar, Continuous flow analyzer for radioactivity in eluates from chromatographic columns, 18: 19870
SKALKA, M., Effect of low radiation doses on the release of deoxyribopolynucleotides in tissues, 18: 19630
SKARSVAG, K., Prompt neutrons from slow neutron fission of U-235, 18: 21198 (KR-64(Sect.XIX))
SKAVRONSKAYA, A. G., Effects of γ radiation on autotrophic mutants of *coliform bacterium*, 18: 19688
SKILLERN, C. P., Human response related to measured sound pressure levels from ultrasonic devices, 18: 21704 (HW-SA-3028)
SKINNER, William Carey, Ultrafiltration with metal membranes, 18: 19934 (NP-13874)
SKLYANSKAYA, E. (Ye.) I., Cellular shifts in lymph nodes of irradiated animals vaccinated against influenza, 18: 19557 (JPRS-23956(p.18-26))
SKOBELEV, N. K., Spontaneous fission of element 102 isotope with mass number 256, 18: 21183 (JINR-P-1580)
SKOFF, R., Prog. rpt. on thermionic converter, 7/63, 18: 20832 (GA-4511)
SKOWRONEK, M. Maurice, Current intensity in an ionized canal of a weak section, 18: 21482
SKURIKHINA, M. M., Desoxycytidine excretion with urine following irradiation, 18: 19684
SLATER, A. J., Sensitive embryonic sites in Tribolium, 18: 19668
SLATER, John V., Sensitive embryonic sites in Tribolium, 18: 19668
SLATER, William E., Properties of Ξ hyperons, 18: 20959
SLEPIAN, Joseph, Comment on single-particle cyclotron radiation, 18: 21417
SLOVACEK, R., Energy-dependent extrapolation length in polyethylene, 18: 21132 (RPI-328-4)
SMALLMAN, R. E., Stacking-fault energy of some pure f.c.c. metals, 18: 20550
SMARS, Erick A., Linear high-current discharge, 18: 21534
SMIRNOV, B. M., Resonance charge exchange in slow collisions, 18: 20769
SMIRNOV, K., Radioisotopic densitometer for liquids, 18: 20320
SMIRNOVA, M. N., Simultaneous determination of Zr, Hf, Th, and Ti in ores, 18: 19912
SMITH, C. K., Converter performance test of a Re emitter, 18: 20878
SMITH, D., Ion and charge exchange reactions, 18: 20810
SMITH, D., Ionization phenomena in Hg vapor, 18: 21476
SMITH, E. T., Prog. rpt. on effects of nuclear radiation, vacuum, and cryotemperatures on engineering materials, 6–8/63, 18: 20581 (FZK-172)
SMITH, Gerald A., Existence of Kπ resonant state at 726 Mev, 18: 20918 (UCRL-10797)
SMITH, H. P., Jr., Pressure wave generated in fissionable gas by neutron irradiation, 18: 21268
SMITH, Harold H., Incorporation of H^3-arginine in chromosomes, 18: 19518 (BNL-7007)
SMITH, J. Chandler, Radiation pneumonitis, 18: 19566
SMITH, J. R., Chemical interaction of oxides with metals, 18: 19981
SMITH, James C., X-ray-conditioned saccharin aversion, 18: 19667
SMITH, L. H., Uptake of Fe-59 by spleens of irradiated mice, 18: 19594
SMITH, Lowell R., Prog. rpt. on liquid metal boiling heat transfer, 8/15–11/15/63, 18: 20160 (AD-423679)
SMITH, Lowell R., Prog. rpt. on liquid metal boiling heat transfer, 11/15/63–2/15/64, 18: 20166 (NP-13810)
SMITH, Willy, Void fraction in cavitating Hg, 18: 20167 (NP-13812)
SMOLENSKAYA, I. N., Mitosis and interkinesis in mouse tissues, 18: 19609
SMOLIAR, V., Effect of cystamine and cysteamine on x-irradiated hair follicles, 18: 19784
SMOLUCHOWSKI, R., Volume expansion and coloration in x-irradiated NaCl, 18: 20598
SMOLYAKOV, V. Ya., Certain properties of electric arc burning in direct current plasmatrons, 18: 20662
SMUTZ, Morton, Solvent extraction of system rare earth nitrates–HNO_3–H_2O–TBP, 18: 20098 (IS-780)
SMYTH, Charles P., Dielectric behavior of H_2O and D_2O in dioxane, 18: 19957
SMYTH, H. T., Effect of neutron irradiation on fused silica, 18: 20616
SMYTHE, L. E., Adsorption of water and CO_2 on BeO, 18: 20014
SNIEGOSKI, Lorna T., Tritium-labeled compounds. X., 18: 20031
SNOEK, C., Ionic bombardment of metallic surfaces, 18: 20783
SNOEK, C., Sputtering of Cu by ion bombardment, 18: 20784
SNOW, G. A., Orbital angular momenta in $\Sigma^{\pm}$ mesonic decays, 18: 20914 (TID-20488)
SNOW, G. A., S-wave hyperon-nucleon interactions and SU_3 symmetry, 18: 20913 (TID-20483)
SNYDER, Paul E., Reactions of Be in oxidizing environments, 18: 19985
SNYDER, R. E., 4π Beta spectrometer, 18: 20360
SOAR, Geoffrey Keith, Improvements relating to storage apparatus, 18: 21583
SOBUE, Hiroshi, Copolymerization of tetrafluoroethylene with ethylene, 18: 20067
SODEN, R. R., System $ThAl_2$–$ThMn_2$, 18: 20554
SODICKSON, L., Observation of $f^0 \rightarrow 2\pi^0$, 18: 20960
SOFRATOV, P. A., Measurement of flow velocity of heated gases by spark photographing, 18: 20188
SOIFER, G. B., Apparatus for observing NQR, 18: 19994
SOKLOV, S. N., Resonance density in scattering on bound particles, 18: 20906 (JINR-P-1562)
SOKOVISHIN, V. A., Resolving power of Ar ionization chamber, 18: 20393
SOLD, U., Tunnel diode single-channel pulse-height analyzer, 18: 20302
SOLDATENKOV, T. R., Plasma equilibrium in space-periodic magnetic field, 18: 21434
SOLOV'EV, V. G., Octupole states of even-even strongly deformed nuclei, 18: 21172 (JINR-E-1561)
SOLOV'EVA, V. N., Attenuation in spiral wave guide, 18: 20315
SOLOVIEV, V. G., Energies of even-even strongly deformed nuclei, 18: 21178 (JINR-P-1568)
SOLUNSKII, V. I., Volume recombination in ambipolar diffusion in plasma gas discharge, 18: 21433
SOMERVILLE, David T., Solid state spectroscopy: infrared absorption of decaborane, 18: 19937 (TID-20514)
SOMMER, H. F., Cobalt-60 γ irradiator, 18: 20419
SORENSEN, Lief B., Liver scanning with Mo-99, 18: 19834
SORRIAUX, A., Total neutron cross section measurements on Al, C, F, and H, 18: 21159 (CEA-2399)
SPAIN, I. L., Evaluating defects in graphite, 18: 20542
SPECHT, E. R., Status of ASCR critical and subcritical experiments, 18: 21599 (NAA-SR-Memo-9382)
SPEDDING, F. H., Phase systems Y–Nd and Sc–Nd, 18: 20520 (IS-841)
SPEHL, H., g-Factor of 155-kev 2 level of Os-188, 18: 21244
SPENCER, A. J. M., Electrolytic dissolution in a potential gradient, 18: 20000
SPIEGLER, K. S., Self-exchange measurements in a chelating ion-exchange resin, 18: 19972
SPIGT, C. L., Heat transfer and stability in BWR, 18: 20177 (TID-7694 (p.53-60))
SPIJKERMAN, Jon J., Limit of the continuous x-ray spectrum, 18: 20653
SPILLER, K.-H., Physical properties of liquid metals, 18: 20516 (EUR-599.d)
SPILLMANN, Werner, Safety device for neutronic reactor, 18: 21588
SPINK, H. C., Magnetic deflection of high-current arcs in air, 18: 21487
SPINRAD, R. J., Computer-centered data handling systems, 18: 21699 (BNL-7841)
SPIRCHEZ, M., Mean number of π^0 mesons produced in inelastic π^--p collisions, 18: 20902 (JINR-E-1557)
SPITSYN, Vikt. I., Concentration of Pa-231 from U processing wastes,

18: 20105
SPRINGER, A., Scattering of 65-Mev He ions from O-16, 18: 21260
SPRONK, N., Sodium separation from biological material, 18: 19841 (CONF-187-112)
SPRUCH, Larry, Improved minimum principle for multichannel scattering, 18: 21050
SRINIVASAN, S. K., Fluctuation problem in EM cascades. II., 18: 20978
SRIVASTAVA, S. C., Complex formation between U and thiomalic acid, 18: 19947
SRIVASTAVA, Yogendra N., Nuclear pair-correlation function via electron scattering, 18: 21356
STAAS, F. A., Laminar and turbulent flow of He-II in wide capillaries, 18: 20800
STACHURA, Jerzy, Resistance of C_{57} black mice to irradiation leukemia, 18: 19663
STAMER, P., τ^+ analysis, 18: 21018
STAMMBACH, K., Adsorption of Rn on activated charcoal and silica gel, 18: 19940 (SC-T-64-613)
STANDIL, S., Anisotropy of primary cosmic radiation at the earth, 18: 20819
STARNER, J. W., Observation of the 1/2+ (411) orbital in Ho-165, 18: 21162 (CONF-481-3)
STARODUBTSEV, S. V., EPR of γ-irradiated quartz crystals, 18: 20587
STAROVOIT, I. A., Coprecipitation of Pu with $Fe(OH)_3$, 18: 19915
STARY, J., Substoichiometric determination of traces of metals, 18: 19852 (UJV-992/63)
STARY, Jiri, Chelating radiometric titrations, 18: 19899
STEBEN, J. D., Scattering of 5- to 15-Mev protons from Be-9, 18: 21362
STECH, Berthold, Induced pseudoscalar interaction and μ capture in He-3, 18: 21326
STECHER-RASMUSSEN, F., Multiple mirror reflection of thermal neutrons, 18: 21126 (KR-64(Sect.XXIV))
STEEB, S., Reactor materials, 18: 21558
STEELE, B. R., Preparation of ceramic-grade BeO, 18: 20503
STEELE, Howard, Molybdenum as an emitter material, 18: 20872
STEELE, L. R., Transient behavior of two-phase forced circulation flow through channels permitting cross-flow, 18: 20165 (NAA-SR-Memo-8123)
STEHLIK, G., Neutron activation analysis in nucleic acids, 18: 19892
STEIN, Otto L., Effect of D_2O on *Pisum sativum* and *Zea mays*, 18: 19662
STEINBERG, M., Analysis of $Eu(C_2O_4)_3$ and Eu(II) salts, 18: 19897
STEINSVOLL, O., Treatment of polarized thermal neutron beams, 18: 21125 (KR-64(Sect.XXIII))
STELSON, P. H., Coulomb excitation of Cu-63 and Cu-65, 18: 21281
STEPANOV, V. D., Measurement of multiple scattering parameters in Xe chambers, 18: 20396
STEPANYAN, E. D., Phagocytic activity of leukocytes of immunized rabbits due to radiation, 18: 19736
STEPANYAN, E. D., Radiation effects on formation of antibodies in combined administration of various antigens, 18: 19735
STEPHAN, H., Electron beam melting and welding in nuclear technology, 18: 20491
STEPHENS, D. R., Compression of some rare earth elements, 18: 20553
STEPHENS, D. R., Thermal conductivity of rock salt, 18: 20530 (UCRL-6894(Rev.II))
STEPHENSON, J. W., Jr., Control of fast reactors, 18: 21561 (APEX-603(Del.))
STEPHENSON, R. L., Mechanical properties of refractory metals, 18: 20456 (ORNL-3593)
STERN, Donald, Absolute decay rate for $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$, 18: 20966
STETSON, A. R., Emittance measurements of refractory oxide coatings, 18: 20565
STEUDEL, A., Isotopic shift in Zr-I spectra, 18: 20002
STEVENS, Richard M., Perturbed Hartree-Fock calculations. II., 18: 19958
STEVENSON, M. L., K^--p elastic scattering at 2.00 Bev/c, 18: 20954
STEVENSON, Wayne, Chain reactions in chemiluminescent oxidation of phthalazinediones by K peroxydisulfate, 18: 21722 (TID-18810)
STEWART, Elizabeth Z., Data from epidemiological follow-up of New Jersey Ra cases, 18: 19550 (NYO-2181-1)
STEWART, J. C. C., Development and manufacture of Magnox fuel, 18: 20463
STEWART, J. R., Photoproton cross-section for O-16, 18: 21163 (CONF-481-4)
STICHEL, P., Bethe-Salpeter structure of nonrelativistic three-nucleon problem, 18: 20930
STIER, H.-E., Study of cathode sputtering of metal crystals, 18: 20785
STOCKER, B. J., Inert-gas glow discharge, 18: 21452
STOEBE, T. G., Motional narrowing of NMR lines in LiF, 18: 19991
STOENNER, R. W., Temporal and spatial variation in cosmic rays, 18: 20815 (BNL-7948)
STOKES, C. S., Centrifugal plasma jet furnace, 18: 20157
STOKLOSA, Edmund, Radiation effects on guinea pig adrenal gland, 18: 19710
STOLETOV, G. D., Polarization investigation in proton scattering at high energy, 18: 20383
STOLETOV, G. D., pp-Phase shifts at 657 Mev, 18: 20992
STONE, J. A., Influence of high pressures on Mossbauer effect in Dy-161 18: 21214 (UCRL-10630(Rev.))
STONE, J. T., Analog simulator results for Pathfinder, 18: 21628 (ACNP-63033)
STONEKING, Charles E., Prog. rpt. on impact effects on spherical shells, 11/63–2/64, 18: 20195 (SC-DC-64-383)
STOODLEY, L. G., ESR spectrometer for use while irradiating wet biological systems, 18: 20293
STORER, John B., Recovery from radiation injury in mammals, 18: 19762
STORK, Donald H., Properties of Ξ hyperons, 18: 20959
STORY, J. S., Data in Winfrith nuclear data library, 7/63, 18: 21156 (AEEW-R-351)
STRAESSLER, S., Superconductivity in antiferromagnets, 18: 21103
STRAX, H., Measurement of neutron-proton polarization at 126 Mev, 18: 20934
STREATER, R. F., Axioms for multi-local fields, 18: 21056
STREATER, R. F., Intensive observables in quantum theory, 18: 21026
STREET, K., Jr., Excess-kinetic-energy ions in organic mass spectra, 18: 20026
STREIB, William E., X-ray diffraction, 18: 19866
STROBRIDGE, T. R., Prog. rpt. on cryogenic magnetic refrigeration, 2/64, 18: 21095 (NBS-8239)
STROEMGREN, Bengt, Continuous spectra of main-sequence B stars, 18: 20714
STROKAN, N. B., Characteristics for determining energy resolution of Si n-p detectors, 18: 20395
STRONGIN, Myron, Surface superconductivity in type I and type II superconductors, 18: 21101
STRONSKI, Ignacy, Solvent extraction in radiochemistry, 18: 20085
STROUD, P. T., Extraction of high-current ion beams, 18: 20741
STRZHIZHOVSKII, A. D., Effect of radiation on regenerative processes related to blood letting, 18: 19611
STUART, R. V., Velocity distribution of sputtered atoms, 18: 20788
STUART, W. F., Rubidium self-oscillating magnetometer for earth's field measurements, 18: 20294
STUART, W. I., Adsorption of water and CO_2 on BeO, 18: 20014
STUART, W. I., High-temperature reaction between BeO and H_2O, 18: 20016
STUBER, P., Linear parallel-to-aerial conversion, 18: 20290
STUHLINGER, E., Thrust units for power-limited propulsion systems, 18: 20639
STURM, B., Calculation of D_2O-moderated lattices, 18: 21596 (EUR-597.e)
STYCZEN, J., Magnetic interaction excited state of Gd-155 with electronic shell, 18: 21211 (PAN-299)
SU, C. H., Kinetic theory of weakly coupled gases, 18: 21376 (MATT-238)
SUBRAMANIAN, M. S., Determination of C in U and Pu carbides, 18: 19902
SUGIMOTO, Kenzo, Quadrupole moment of second excited state of F-19, 18: 21276
SUKEGAWA, Takashi, E vs. B curve hysteresis in the positive column, 18: 21403
SULLIVAN, R. J., Detection of adsorbant saturation by radioisotopic analysis, 18: 21553 (NAA-SR-Memo-7771)
SULYAEV, R. M., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
SUMARUKOV, G. V., Oxidation-reduction potential as index of radiation protection, 18: 19680
SUMMERFIELD, G. C., One-speed neutron transport in adjacent half-spaces, 18: 21140
SUMMERFIELD, G. C., One-speed neutron transport in adjacent half spaces, 18: 21133 (TID-20503)

SUMMERS, William C., X irradiation of the tumor bed, 18: 19695
SUND, R. E., Delayed γ rays from photofission of U-238, U-235, and Th-232, 18: 21298
SUNDARAM, K., Oral leukoplakia after deep x-ray irradiation, 18: 19624
SUNDARAM, T. R., Research in hypersonics and magnetohydrodynamics, 18: 20119 (ARL-64-5)
SUNDARESAN, M. K., Thermal conductivity of fully ionized gas, 18: 21397
SUNG, Yung-tsung, Rotational energy levels of Tb-160, Ta-182, Re-186, and Re-188, 18: 21312
SUPAN, E. C., Fabrication of hexagonal APM process tubes for OMR, 18: 21569 (NAA-SR-Memo-8121)
SUPEK, Z., Effect of cystamine on urinary excretion of 5-hydroxyindole-acetic acid in x-irradiated rats, 18: 19639
SUPEK, Z., Relationship between dose of x irradiation and urinary excretion of 5-hydroxyindoleacetic acid in rats, 18: 19626
SUSLIKOV, V. I., Protective properties of diethylstilbestrol, 18: 19799
SUSMAN, Sherman, Color center phenomena in zone-refined KCN, 18: 20040 (COO-1044-15)
SUTHERLAND, John Paul, EHD generator for an alternating input, 18: 20833 (GA/PHYS/63-11,12)
SUZUKI, Arts, Elastic scattering of protons from Cu-63 and Cu-65, 18: 21171 (INSJ-68)
SVEC, H. J., Deuterium exchange in the pyridoxal–leucine system, 18: 20027
SVEC, Harry J., Isotopic composition of V from organic sources. I., 18: 19519 (IS-655)
SVECHNIKOV, S. V., Investigating parameters of relaxation processes, 18: 20078
SVEDBERG, J., Alpha-active isomers in Bi-201 and Bi-199, 18: 21258
SWAIN, A. D., Human factors in design of reliable systems, 18: 21719 (SC-R-748)
SWEET, William H., Scanning with positron-emitting radioisotopes, 18: 19817
SWIFT, D. A., Impulse discharges in crossed electric and magnetic fields, 18: 21501
SWINDEMAN, R. W., Thermal shock tests on BeO, 18: 20571
SZEPKE, R., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
SZLEPKA, Geza, Investigation of cervix carcinoma, 18: 19701
SZUMLEWICZ, Alina Perlowagora, Age of snails and susceptibility to x irradiation, 18: 19698
SZWARCBAUM, G., Inelastic scattering matrices for fast reactor calculations, 18: 21598 (IA-899)

T

TABATA, Yoneho, Copolymerization of tetrafluoroethylene with ethylene, 18: 20067
TABER, Richard Lawrence, Steric inhibition in liquid scintillators, 18: 20036
TACHIKAWA, Kyoji, Superconducting current capacities of Nb–Zr alloys, 18: 21098
TACONIS, K. W., Laminar and turbulent flow of He-II in wide capillaries, 18: 20800
TAEGER, F., Febrile reactions during Ra and radiocobalt insertions, 18: 19792
TAFT, H. D., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)
TAGLIORETTI, D., Distribution of Bi-206 in the rat, 18: 19529
TAILLET, J., Dipolar resonance effect on discharge, 18: 21515
TAINSH, R. J., Thermal conductivity of neutron-irradiated BeO, 18: 20611
TAKAHASHI, Hachiro, Magnitude of cosmic-ray storms, 18: 20818
TAKAHASHI, Toshitake, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
TAKAHASHI, Yasuo, Determination of Zr, B, C, and Si in ZrB_2, 18: 19882
TAKEDA, Yasunosa, Deformation of theta-pinched plasma, 18: 21402
TAKEISHI, Y., Auger-type interaction of ions with solid surfaces, 18: 20780
TAKEMOTO, H., Role of lymphoma virus in x-ray induction of myeloid leukemia, 18: 19578
TAKENO, Hyoitiro, Theory of spherically symmetric space-times, 18: 20658
TAKESADA, Yoshihito, Magneto-acoustic waves in presence of magnetic field, 18: 20643
TAKETA, S. Tom, Delayed radiation effects in abdomen-irradiated rats, 18: 19587
TAKEUCHI, Sakae, Reaction of U with graphite, 18: 19984
TAKIKAWA, Kiyoshara, Bone marrow cells of irradiated rats, 18: 19660
TAMAGNINI, M. G., Comparison between codes for calculation of thermal spectra in homogeneous media, 18: 21122 (EUR-1605.e)
TAMPAS, John P., Exposure control in cineradiography, 18: 19829
TANAKA, Hiroshi, Effect of slight shift of fuel elements on reactivity of UTR-B, 18: 21684
TANAKA, Minoru, Electronic states in liquid metal, 18: 20628 (NP-13844)
TANAKA, Osamu, Neutron and γ discrimination in organic scintillators, 18: 20350
TANG, Hsiao-wei, Counters with controlled pulse supply. I., 18: 20406
TANG, Y. C., Eigenvalue of a three-body system, 18: 21048
TANKA, D., Change of function of suprarenals with acute radiation injury, 18: 19676
TAPLIN, George V., Colloidal radioalbumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
TARASENKO, A. G., Mechanism of cystamine radiation protection, 18: 19800
TATEBAYASHI, K., Stability of natural rubber, 18: 21735 (SC-T-64-610)
TATISHVILI, D. G., Voltage-current characteristics and current oscillations in low-pressure thermionic converters, 18: 20840
TAVENDALE, A. J., Application of Li-drift Ge γ spectrometers at high energies, 18: 20374
TAYLOR, S., τ^+ analysis, 18: 21018
TEAR, Joan, Radiation effects on marine *Pseudomonas sp.* I., 18: 19627
TEAR, Joan, Radiation effect on marine *Pseudomonas sp.* II., 18: 19628
TEDFORD, D. J., Static breakdown voltage of uniform-field spark gaps, 18: 20602
TEICHMANN, J., Plasma jets in magnetic fields, 18: 21486
TEITEL, Robert J., Processing Th–Bi and Th–Pb, 18: 20118
TEMPELMEYER, K. E., Vortex flow in arc heaters, 18: 21393
TEMPERLEY, H. N. V., Soluble model of classical imperfect gas in a vessel, 18: 20655
TEPLITZ, V. L., Three-body final-state interactions in special case, 18: 20916 (UCRL-10773)
TEPPER, Luis, Beam profile indicator with solid state detectors, 18: 20327 (BNL-7880)
TERENZI, M., Intense artificial radioactivity in autumn 1962, 18: 21082
TERESHCHENKO, O. Ya., Desoxycytidine excretion with urine following irradiation, 18: 19684
TERHUNE, R. W., Calculation of explosion-produced craters, 18: 20123 (UCRL-7738)
TER-POGOSYAN, R. A., Effects of x radiation on reproduction of smallpox vaccine virus, 18: 19687
TER-POGOSYAN, R. A., Induction of bacteriophages from *E. coli* cultures under x irradiation, 18: 19739
TER-POGOSYAN, R. A., Stimulating effect of local skin x irradiation on production of agglutinins, 18: 19738
TERRALL, John R., Procedure for including anisotropic scattering in neutron slowing-down calculations, 18: 21135 (UCRL-7006-T)
TERRIS, David, Platinum resistance thermometer circuit with 5 volts output, 18: 20283 (NAA-SR-Memo-8073)
TESTA, C., Determination of Th in urine, 18: 19917
TEWORDT, Ludwig, Electronic thermal conductivity of superconductors, 18: 21100
THEIMER, Otto H., Scattering of EM radiation by ionized gases, 18: 21540
THEISEN, Roger, Application of x-ray microanalyzer for cold-worked Al, 18: 20562
THENARD, J., Time-of-flight encoder with variable band width, 18: 20363
THIBODEAU, Robert Douglas, Optimization of a two-stage reactor system, 18: 20156
THIESS, Frank Bartlett, Invariant distributions of quantum field theory, 18: 21068
THOMAS, C., Association of Ag(I) and chloride in molten Cs nitrate, 18: 19975
THOMAS, E. D., Fate of H^3-thymidine-labeled bone-marrow cells in irradiated recipients, 18: 19769
THOMAS, E. D., Supralethal whole-body irradiation and marrow transplantation, 18: 19764

THOMAS, E. Donnell, Survival of lethally irradiated dogs, 18: 19603
THOMAS, Terence Felix, Improvements relating to steam generating equipment, 18: 21663
THOMPSON, M. A., $\omega-\rho$ interference, 18: 21017
THOMPSON, R. W., Prog. rpt. on high-energy fundamental particles, 6/63, 18: 20325 (AROD-2427:1)
THORSEN, A. C., Low-field de Haas-van Alphen effect in Cu, 18: 20755
THOSAR, B. V., Nuclear levels of Au-199, 18: 21243
THURSTON, H. G., Application of sealed-source regulations, 18: 20243
THYER, J. R. W., Electron spin resonance in irradiated BeO, 18: 20614
TICHO, Harold K., Properties of Ξ hyperons, 18: 20959
TICKNER, A. W., Positive ions in CO_2 glow discharge, 18: 21455
TIKTOPOULOS, George, Scattering by strongly singular potentials, 18: 21049
TILL, J. E., Repair in irradiated mouse hematopoietic tissue, 18: 19761
TILLMANNS, G., Dosimetry of γ radiation with ferrocenes in CCl_4, 18: 20402
TIMAN, B. L., Volume recombination in ambipolar diffusion in plasma gas discharge, 18: 21433
TIMM, Manfred, Nucleoside phosphate in organs of rats after whole-body irradiation, 18: 19702
TIMONOVA, M. A., Corrosion of Mg alloys with rare earths and other elements, 18: 20482
TING, Sui-din, Internal fraction due to dislocations in Mo, 18: 20559
TINSLEY, B. A., Spectrogram of artificial aurora near Samoa, 18: 21073
TIPPETS, F. E., Two-phase flow and heat transfer studies at GE, 18: 20172 (TID-7694(p.24-34))
TISHCHENKO, B. I., Equilibrium form of light nuclei, 18: 21307
TISHIN, V. G., Resonance h-f electric discharge and possibilities of depressing it, 18: 20663
TITLE, Reuben S., Spectra of $3d^3$ configuration of Cr in ZnSe and ZnTe, 18: 20019
TKACHEV, A. V., Distribution of Po-210 in hypophysis, thyroid, and parathyroid, 18: 19542
TOBE, Tatsuo, Transplantability of Yoshida ascites tumor cells. I., 18: 19651
TOBIAS, C. A., Molecular and cellular effects of ionizing radiations, 18: 19571
TOBIAS, C. A., Sensitive embryonic sites in Tribolium, 18: 19668
TOCANTINS, L. M., Survival of skin homografts in mice with bacterial infection, 18: 19511
TOKSOEZ, M. Nafi, Excitation of seismic surface waves by nuclear explosions, 18: 21081
TOLSON, G. M., Manufacture of EGCR core I fuel assemblies, 18: 21653
TOMA, Sam Z., Hydrogen formation in the cyclohexane radiolysis, 18: 20057
TOMLINSON, R. B., Fast-slow coincidence system, 18: 20345
TOMOZAWA, Y., Antiproton-proton collision in unitary symmetry model, 18: 20953
TOMOZAWA, Y., Experimental test of unitary symmetry model, 18: 20962
TONIN, M., Vertex renormalization in potential theory, 18: 21038
TONTEGODE, A. Yu., Probe characteristics in gaseous discharge plasma, 18: 21438
TO-ON, Moon, Determination of P by fast neutron activation, 18: 19850 (TID-20472)
TOPTYGIN, I. N., Theory of bremsstrahlung and pair production, 18: 20984
TOROPOVA, V. F., Polarographic catalytic H currents and determination of Be, 18: 19908
TOTH, Ferenc, Investigation of cervix carcinoma, 18: 19701
TOTTER, John R., Chain reactions in chemiluminescent oxidation of phthalazinediones by K peroxydisulfate, 18: 21722 (TID-18810)
TOUL, Yan, Valency of Re during reduction, 18: 20005
TOVE, P. A., Distribution of charged particles in aurorae, 18: 20364
TOZER, B. A., Impulse discharges in crossed electric and magnetic fields, 18: 21501
TRAIGER, H. L., Development of gasoline-fueled thermionic engine, 18: 20887
TREIMAN, S. B., Multiple scattering in the diffusion approximation, 18: 20924
TREIMAN, S. B., Scattering by strongly singular potentials, 18: 21049
TRET'YAKOV, E. F., Activation cross section of Cd-108 by thermal neutrons, 18: 21220
TRINKS, H., Thin-layer electrophoresis application to separation of phenols and phenolic acids, 18: 21736 (SC-T-64-615)
TRIPLETT, J. R., GAPLSN—program for solution of one-dimensional anisotropic transport equation, 18: 21123 (GA-4972)
TRLIFAJ, L., 4-Particle wave function in SU, scheme, 18: 21215 (UJV-1002-63)
TROBAUGH, F. E., Jr., Transplantation potential of hematopoietic tissue, 18: 19527
TROBAUGH, F. E., Jr., Transplantation potential of fresh and stored bone marrow, 18: 19777
TROST, W., 10.43-Mev state in N-14, 18: 21261
TROUP, G. J., Paramagnetic resonance of Gd^{3+} in zircon, 18: 19945
TROUP, G. J., Resonance of Be-9 in single crystals of BeO, 18: 20017
TRUSEWICZ, E., Decontamination factors of filtration plant of Warsaw, 18: 20229 (CLOR-23)
TSAI-CHU, Electrons in antinucleon annihilation stars, 18: 20928
TSELUIKIN, V. A., Effective light collection by conical light pipes, 18: 20399
TSUBOTA, Hiroyuki, Determination of Cs-137 and Sr-90 in fallout, 18: 19880
TSUDA, Minoru, Hydroxyl radicals in γ radiolysis of aqueous benzene, 18: 20047
TSUKUDA, M., Simple pulse voltage dividing circuit, 18: 20358
TSUPKO-SITNIKOV, V. M., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
TSUTSUMI, Ken-ichi, Application of solvent extraction to Th analysis, 18: 19885
TSUTSUMI, Ken-ichi, Solvent extraction of Th from rare earths with acetyl acetone, 18: 20106
TUBIANA, M., Hematological responses to whole-body irradiation, 18: 19584
TUNITSKII, N. N., Ionization encounters of electrons with ions and atoms, 18: 20768
TURNER, D. T., Radiolysis of polyisobutene. I., 18: 20064
TURNER, D. T., Radiolysis of polyisobutene. II., 18: 20065
TURNER, D. T., Radiolysis of polyisobutene. III., 18: 20066
TURNEY, G. E., Description of pool boiler, 18: 21554 (NAA-SR-Memo-8061)
TUROS, A., Improving the resolution of time-of-flight spectrometer, 18: 20338 (PAN-469/I)
TUSTING, Robert F., Evaluation of C-70045A high-speed photomultiplier, 18: 20343 (UCRL-11147)
TYUTYUGIN, I. I., Probability of ternary fission of U-235 and U-238, 18: 21219

U

UBBELOHDE, A. R., Evaluating defects in graphite, 18: 20542
UESAKA, Yasumasa, E vs. B curve hysteresis in the positive column, 18: 21403
UHLENBROCK, Dietrich Albert, Meissner effect and flux quantization in quasiparticle picture, 18: 20667
UHLMANN, W., Bibliography on corrosion-resistant Nb alloys, 18: 20475 (VDDIT-87)
ULLRICH, H., Reaction $Si^{28}(\gamma,p)Al^{27}$, 18: 21325
ULRYCH, T. J., Gas source mass spectrometry of trace leads, 18: 20203
UMERJEE, R. K., Pion-hyperon resonances, 18: 21006
UMERJEE, R. K., Quantization of self-coupled boson field, 18: 21002
UNDERHILL, Glen, Simple models for the Be-9 nucleus, 18: 21349
UOTINEN, V. O., Reactivity of mixed oxide fuel elements, 18: 21613 (HW-79960)
UPTON, A. C., Late somatic effects of x radiation in mice, 18: 19795
UPTON, A. C., Myeloid leukemia in the mouse, 18: 19577
USHER, M. J., Rubidium self-oscillating magnetometer for earth's field measurements, 18: 20294
UZORIN, E. K., Effects of γ irradiation of seeds on development of nicotiana plants, 18: 19690

V

VACZO, Gyorgy, Effects of irradiated bone marrow on liver regeneration of rats, 18: 19790

VACZO, Gyorgy, Question of radiotoxins, 18: 19653
VAINSHTEIN, L. A., Diffraction of open resonators and wave guides with plane mirrors, 18: 20313
VAINSHTEIN, L. A., Open resonators with cylindrical mirrors, 18: 20314
VAKHIDOV, Sh. A., EPR of γ-irradiated quartz crystals, 18: 20587
VAL'DSHTEIN, E. A., Restoration of *E. coli* irradiated under various conditions, 18: 19681
VALENTINE, Robert H., Thermodynamic properties of inorganic substances. VII., 18: 19955
VALENTINI, R., Distribution of Bi-206 in the rat, 18: 19529
VALETTE, Leon Jean, Improvements in gas-cooled reactors, 18: 21664
VALI, V., Low-energy γ spectroscopy, 18: 20373
VALIGI, Mario, Calcium and Zr phosphate, 18: 19944
VALUEV, B. N., Anomalous singularities and amplitudes for some processes, 18: 20903 (JINR-E-1581)
VALYI-NAGY, T., Antagonistic actinomycetae in Hungarian soils. VI., 18: 19560
VAN ASBROECK, Ph., Fabrication of particulate-type fuels, 18: 20492
VAN DASSEN, W., Welding of Al for reactor construction, 18: 20490
VAN DE HULST, H. C., Interstellar gas and the galactic halo, 18: 20724
VAN DER LEUN, C., Energy levels of Ar-36 and Ar-38, 18: 21264
VANDERSLICE, J. T., Quantum effects in small-angle molecular-beam scattering, 18: 20736
VANDERVELL, H. D., Biological monitoring at Harwell, 1961 and 1962, 18: 20208 (AERE-R-4415)
VAN DER WALT, J. J., Use of ferrite memory cores, 18: 20371
VAN HOVE, L., Classification of elementary particles, 18: 20898 (CERN-64-6(p.49-70))
VAN HOVE, L., High-energy collisions of strongly interacting particles, 18: 20971
VAN HOVE, L., Progress in our understanding of elementary particles, 18: 20970
VAN LOAN, P. R., Crystal structure of lime-stabilized zirconia, 18: 20020
VARSHAL, G. M., Gravimetric determination of rare earths in rocks, minerals and alloys, 18: 19909
VASHAKIDZE, I. Sh., Hypertritium binding energy in case of nonlocal interaction, 18: 21182 (JINR-P-1579)
VASILENKO, A. T., Bubble chamber in magnetic field, 18: 20389
VASILEVA, I. A., Measurement of flow velocity of heated gases by spark photographing, 18: 20188
VATAI, Endre, Shell electron capture from various atomic shells, 18: 21228
VAUGHAN, B. E., Ionic relationships of bioelectrogenic mechanism in isolated rat stomach, 18: 19521 (USNRDL-TR-716)
VEEVERS, K., Mechanical testing of BeO, 18: 20573
VEKSLER, V. I., Energy distribution of Ni atoms formed in cathode sputtering, 18: 20666
VENIKOV, N. I., Acceleration of negative ions in IAE cyclotron, 18: 20692
VENINGA, T. S., Radiomimetic toxicity of ozonized air, 18: 19538
VENKATESAN, K., Pion-nucleon resonances, 18: 21004
VENKATESAN, K., Pion-nucleon resonances, 18: 21005
VERBA, J. W., Reaction (He^3,n) on C-12 and C-13, 18: 21259
VERES, Arpad, Tritium determinations by liquid scintillation counter, 18: 19887
VERGEZAC, P., Regulated supply of high stability, 18: 20299
VERMUND, Halvor, X irradiation of the tumor bed, 18: 19695
VICTOR, G., Time-of-flight encoder with variable band width, 18: 20363
VIKIN, B. P., Integrated coincidence γ spectrometer for analysis of complex decay schemes, 18: 20386
VIKULOV, A. I., Effect of halide compounds on oxidation of U(IV), 18: 19943
VILCSEK, E., Diffusion loss of radiogenic and spallogenic rare gases from meteorites, 18: 20206
VINEN, W. F., Critical velocities in liquid He-II, 18: 20797
VINITSKII, A. Kh., Empirical regularity in excited system mass distribution, 18: 20975
VINOGRADOV, A. I., Theoretical-numerical basis of stochastic number theory, 18: 21734 (ORNL-tr-42)
VISCONTI, J. A., Refractory alloys, 18: 20485 (ASD-TDR-62-670(Pt.II))
VISFELDT, Jakob, Cell cultures from irradiated human skin, 18: 19563
VISHNEVETSKII, M. Z., Attenuation in spiral wave guide, 18: 20315
VISHNYAKOV, V. A., Optimum frequency shift in injector accelerator, 18: 20705
VLASENKO, S. P., Effect of toxins on O consumption by irradiated rats, 18: 19742
VLASENKO, S. P., Effect of insulin on O consumption and survival of x-irradiated rats, 18: 19806
VLASOV, P. V., Utilizing radioisotopes in wearing process, 18: 20424
VODOPIVEC, F., Iron surface enrichment by As, 18: 19903
VOGEL, Howard H., Jr., Fractionated, low dose-rate irradiation of mice, 18: 19576
VOGEL, P., Octupole states of even-even strongly deformed nuclei, 18: 21172 (JINR-E-1561)
VOITSENYA, V. S., Motion of dense plasma clusters in toroidal solenoid magnetic field, 18: 21437
VOLEK, Vladimir, Influence of combined radiation on activity of lactic acid dehydrogenase, 18: 19705
VOLKOVA, O. I., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
VOLLAND, H., Reflection of EM waves at plasma, 18: 21441
VOLPI, G. G., Charge-exchange between rare-gas ions and molecules, 18: 20742
VON DARDEL, G., Neutrino experiments, 18: 20900 (CERN-64-6(p.99-123))
VON ENGEL, A. H., Emission processes at cathodes of vacuum arcs, 18: 20143
VON ESSEN, Carl F., Some thoughts on the time factor, 18: 19802
VON GUSTORF, E. Koerner, Dosimetry of γ radiation with ferrocenes in CCl_4, 18: 20402
VON STEIN, D. E., Production of Be-7 by photoeffect on Be, B, and C, 18: 21328
VON SYDOW, Erik, Radiation effects on marine *Pseudomonas sp.* 1., 18: 19627
VON WEYSSENHOFF, H., Gamma radiolysis of CO in presence of rare gases, 18: 20087
VOROB'EV, G. A., Operation of Arkad'ev-Marx circuit with high duty factor, 18: 20684
VOROBEV, V. S., Analysis of solutions and silicate rocks after solution, 18: 19910
VOROBEV, V. V., Diffusion of Fe in Zr, 18: 20561
VOS, G., Determination of trace minerals in polyphenyls, 18: 19844 (ISPRA-455)
VRUBLEVSKAYA, N. A., Broadening of spectral lines in a strongly ionized plasma. III., 18: 21409
VYDRA, Frantisek, Determination of trace amounts of Co, 18: 19898

W

WACHTEL, A., Self-activated luminescence of M^{3+} niobates and tantalates, 18: 20060
WADDINGTON, C. J., Modulation of heavy nuclei in primary cosmic radiation, 18: 20813 (AD-434176)
WADDINGTON, C. J., Primary cosmic radiation, 18: 20824
WADE, James W., Heavy water reactors for sea water distillation plants, 18: 21632 (DP-866)
WAENKE, H., Diffusion loss of radiogenic and spallogenic rare gases from meteorites, 18: 20206
WAENKE, H., Helium and Ne isotopes in Fe meteorites, 18: 20205
WAENKE, H., Production cross sections for He-3 and Ne-21 from stone meteorites, 18: 20204
WAGGONER, James, Low-temperature chamber, 18: 21729 (UCRL-7349)
WAGNER, H., Penning-discharge with heated cathode, 18: 20154
WAGNER, Herbert, Two-particle approximation for fermion systems, 18: 20980
WAGNER, K. H., Development of an electron avalanche, 18: 21491
WAGNER, R. L., Jr., Measurement of the rate for $\mu^- + He^3 \rightarrow H^3 + \nu$, 18: 21160 (CONF-231-5)
WAGONER, Joseph K., Cancer mortality patterns among U miners and millers, U. S., 18: 20256
WAHL, H., Fast coincidence preamplifier for solid state radiation detectors, 18: 20356
WAHLIG, M., Observation of $P^{\circ} \rightarrow 2\pi^{\circ}$, 18: 20960
WAINE, Peter, Improvements in reactor fuel elements, 18: 21623
WALFORD, L. K., Phase diagram of Al–Mo system, 18: 20549
WALKER, D. G., Damage in neutron-irradiated BeO, 18: 20610

WALKER, D. G., Electron irradiation of BeO, 18: 20604
WALKER, D. G., Growth in irradiated BeO single crystals, 18: 20609
WALKER, D. G., X-ray diffraction studies of irradiated BeO, 18: 20608
WALKER, Jack Vernon, Effects of flux anisotropy on thermal neutron flux perturbations, 18: 21152
WALKER, Robert J., Neutron and α counters for heavy-element column chemistry, 18: 20101 (UCRL-11300)
WALKER, W. D., ω–ρ interference, 18: 21017
WALKER, William Scott, Scattering of 15.2-Mev neutrons by complex nuclei, 18: 21340
WALLING, J. F., Engineering properties of K, 18: 19926 (BATT-4673-FINAL)
WALLING, J. R., Thermodynamic and transport properties of K, 18: 20018
WALLIS, G. B., Two-phase flow and boiling studies, 18: 20176 (TID-7694(p.44-51))
WALTER, J., Resonance of Be-9 in single crystals of BeO, 18: 20017
WALTER, William T., Nuclear orientation and magnetic moment of Hg-195, 18: 21360
WALTERS, Virginia F., Detection of pulse pile ups with tunnel diodes, 18: 20296
WALTNER, Arthur, Measurement of neutron slowing-down time in water, 18: 21148
WALTON, Harold F., Ion exchange chromatography, 18: 19857
WALTON, R. B., Delayed γ rays from photofission of U-238, U-235, and Th-232, 18: 21298
WANG, Ao, Direct production of electron pairs by high-energy charged particles, 18: 21311
WANG, Shih-yuan, Internal fraction due to dislocations in Mo, 18: 20559
WANG, Shun-jung, Spectrophotometric determination of rare earth elements, 18: 19895
WANG, Yeh-ning, Internal fraction due to dislocations in Mo, 18: 20559
WANG, Yung-jen, Charge radius of nucleons by modified propagator, 18: 20976
WANIC, Adam, Magnon scattering of slow neutrons on pyrrhotite single crystal, 18: 21131 (PAN-279)
WARD, A. L., Townsend or streamer breakdown?, 18: 21492
WARD, Carter H., Determination of Mo in U–Mo alloys with α-benzoinoxime, 18: 19846 (LA-3058)
WARE, A. A., Compressibility in MHD stability of diffuse pinch discharge, 18: 21416
WARING, J. L., Tetragonal phases of general type $10M_2O_3 \cdot 90M'_2O_3$, 18: 19942
WARMAN, J. M., Formation of ozone from O by radiations, 18: 20095
WARMOLTZ, N., Interaction of electron beam with inhomogeneous plasma, 18: 21453
WARMUTH, D. B., Prog. rpt. on coated Nb alloys, 11/63–1/64, 18: 20523 (NP-13811)
WARNER, C., Ion-rich, unignited mode of thermionic converters, 18: 20847
WARNER, C., Unigaited mode of thermionic diodes, 18: 20846
WARNOCK, Robert L., Motion of poles as broken resonance multiplet approaches degeneracy, 18: 21016
WASSERBURG, G. J., Strontium contamination in mineral analyses, 18: 19888
WASSON, J. T., Be-7, P-32, P-33, and S-35 stratospheric concentrations, 18: 21080
WATABE, Mitsuo, Electronic states in liquid metal, 18: 20628 (NP-13844)
WATANABE, T., Short-period geomagnetic pulsations, 18: 21076
WATANABE, Tsutomu, Collisional excitation transfer between atoms, 18: 20740
WATSON, Kenneth M., Time correlations for quantum-mechanical systems, 18: 21051
WEBER, D. A., Total-body scanning, 18: 19818
WEBER, E., Influence of diets on radiostrontium retention in skeleton of mammals, 18: 19533
WEBER, K.-H., Simple range-energy-relation for electrons, 18: 20929
WEBSTER, H. F., Work function of the 110 plane of Ta, 18: 20864
WECKEL, K. G., Characteristics of irradiated pork. I., 18: 19616
WECKEL, K. G., Characteristics of irradiated pork. II., 18: 19617
WECKERMANN, B., Beta decay energy of Tc isotopes, 18: 21319
WEDEPOHL, P. T., Vacancy production by x rays in KI, 18: 20656
WEGST, Walter Frederick, Jr., Effects of low-energy x rays on mammalian tissue cells, 18: 19757
WEHNER, G. K., Velocity distribution of sputtered atoms, 18: 20788
WEIDENBAUM, B., UO_2 fuel capability, 18: 21620
WEIDHAAS, Donald E., Release of sterile males for control of *Anopheles quadrimaculatus*, 18: 19654
WEIJSENFELD, C. H., Average energy and yield of sputtered atoms, 18: 20787
WEIL, J. L., Reaction $F^{19}(d,n)Ne^{20}$, 18: 21241
WEILL, M., Experimental study of an r-f Ar torch, 18: 21517
WEINBERG, A. F., Compatibility of U fuels and thermionic emitters, 18: 20874
WEINBERG, D. L., Thermal small-angle x-ray scattering in Si, 18: 20555
WEINBERG, Steven, Feynman rules for any spin. II., 18: 20944
WEINBERGER, Jan Vitoslav, Flexible shield for ionizing radiations, 18: 21548
WEINBERGER, Jan Vitoslav, Shield for ionizing radiations, 18: 21547
WEINREICH, Marcel I., Adsorption of Rn on activated charcoal and silica gel, 18: 19940 (SC-T-64-613)
WEINREICH, Marcel I., Thin-layer electrophoresis application to separation of phenols and phenolic acids, 18: 21736 (SC-T-64-615)
WEINREICH, Marcel I., Thin-layer ionophoresis, 18: 19854 (SC-T-64-49)
WEINSTEIN, J. H., Development of solar thermionic converters, 18: 20879
WEIR, J. R., Jr., Mechanical properties of refractory metals, 18: 20456 (ORNL-3593)
WEISS, Benjamin, Synthesis of palmitaldehyde-1,2-^{3}H, 18: 20025
WEISSLER, Alfred, Fluorometric analysis, 18: 19858
WELLS, F. R., Lymphatic vessels in radiodermatitis, 18: 19604
WEN, T., Strontium contamination in mineral analyses, 18: 19888
WERNICK, J. H., Nuclear hyperfine structure in Er-166, 18: 21272
WERNICK, J. H., System $ThAl_2$–$ThMn_2$, 18: 20554
WERTHEIM, Gunther K., Mössbauer effect in chemistry and solid-state physics, 18: 19998
WERTHEIM, M. S., Analytic solution of the Percus-Yevick equation, 18: 21029
WERZ, Rudolf, Measurements of mixed radiation fields in BR-2, 18: 20379
WEST, E., ω–ρ interference, 18: 21017
WESTERMAN, R. E., Quantitative metallography of hydride phase in Zy-2 process tubes, 18: 20518 (HW-74949)
WESTON, G. F., Effect of active gases on inert-gas glow discharges, 18: 21456
WESTON, Ralph E., Jr., Isotopic fractionation of H, 18: 19968
WESTRUM, E. F., Jr., Thermodynamics of La and Nd hexaborides, 18: 19928 (CONF-405-6)
WETHERELL, A. M., Measuring elastic scattering at very high energy, 18: 20897 (CERN-64-6(p.31-48))
WETHERILL, G. W., Search for natural Cm-247, 18: 20217
WHATHAM, J. F., Mechanical testing of BeO, 18: 20573
WHELTON, James A., Pregnancy after radiation therapy, 18: 19565
WHIPPLE, Harold E., Conference of physical factors and modification of radiation injury, 18: 19569
WHITE, Charles E., Fluorometric analysis, 18: 19858
WHITE, G. K., Thermal conductivity of neutron-irradiated BeO, 18: 20611
WHITEHAIR, L. A., Characteristics of irradiated pork. I., 18: 19616
WHITEHAIR, L. A., Characteristics of irradiated pork. II., 18: 19617
WHITEHEAD, W. D., Neutron photoproduction cross sections of La and Pr, 18: 21278
WHITEHURST, Gordon William, Radioactive selector circuit, 18: 20324
WHITFIELD, H. J., Diffusion of tritium from irradiated BeO powders, 18: 20613
WHITFIELD, H. J., Release of Xe-133 on heating of UO_3–ThO_2–BeO, 18: 20572
WHITING, E. E. Dowling, (p,n) Threshold-curve shapes and measurements of threshold energy with H_2^+ beams, 18: 21284
WHITSTON, O. S., Determination of filter efficiency using radioactive ions, 18: 20239 (NP-tr-1124)
WHITTEN, R. C., Ion kinetics in the lower ionosphere, 18: 21075
WHITTEN, R. C., Reaction rates determined from ionospheric observations, 18: 21094
WICKES, W. H., HNPF carburization surveillance, 18: 21637 (NAA-SR-Memo-8214)
WIEGAND, D. A., Volume expansion and coloration in x-irradiated NaCl, 18: 20598

WIEGMANN, Otto A., Prog. rpt. on radiation thresholds for chorioretinal burns, 8/1/60–1/15/63, 18: 19547 (AMRL-TDR-63-71)

WIEN, K., Beta decay energy of Tc isotopes, 18: 21319

WIENECKE, R., Heat conductivity in an arc column with superposed magnetic field, 18: 21483

WIENECKE, R., Measurements of a stationary d-c He arc, 18: 21484

WIENEKE, J., Copolymerization of amino acids by irradiation with fast electrons, 18: 20074

WIESNER, L., Progress in nuclear, radio-, and radiation chemistry, 18: 20044

WIGNER, E. P., Approximation method in collision theory, 18: 21304

WIKNER, N. F., Neutron thermalization in graphite, 18: 21146

WIKTOR, S., Reaction (d, ^{3}He) on S nuclei, 18: 21210 (PAN-288)

WILHELMI, Z., Improving the resolution of time-of-flight spectrometer, 18: 20338 (PAN-469/I)

WILIP, Elmer K., Physical characteristics of BR-5 reactor, 18: 21683 (ANL-Trans-9)

WILIP, Elmer K., Ultrastructure of variant of Farth mice mastocytoma, 18: 21732 (ANL-Trans-7)

WILKINS, D. H., Volumetric and gravimetric analytical methods for inorganic compounds, 18: 19865

WILL, W., Measurement of r-unit in range of border rays, 18: 19825

WILLI, A. V., Calculation of kinetic isotopes effects. I., 18: 19951

WILLI, A. V., Calculation of kinetic isotope effects. II., 18: 19952

WILLIAMS, A., Ratio of electron capture to position emission in decay of Na-22, 18: 21245

WILLIAMS, Jack, Improvements in or relating to nuclear fuels, 18: 20465

WILLIAMS, M. M. R., Effect of chemical binding on Milne-problem extrapolation distance, 18: 21147

WILLIAMSON, C., Absolute photopeak efficiency for well-type NaI(Tl) crystal, 18: 20076

WILLIAMSON, G. K., Determination of the nature of dislocation loops, 18: 20546

WILLIS, David Lee, Radiotracer methodology in biological science, 18: 19514

WILLIS, E. H., Dating of humus podzols by residual radiocarbon activity, 18: 20223

WILLIS, W. J., Dipion mass spectra in antiproton-proton annihilations, 18: 20894 (BNL-7969)

WILLIS, William J., Bubble chamber track measurements, 18: 20328 (BNL-7932)

WILLMORE, A. P., Energy sources for the ionospheric electrons, 18: 21084

WILNER, Bertil E., Linear high-current discharge, 18: 21534

WILSON, C. R., UO_2 fuel capability, 18: 21620

WILSON, E. G., Energy-transfer phenomena in liquid He, 18: 20756

WILSON, G. F., Liquid scintillation technique for tool-wear determination, 18: 20426

WILSON, H., Gyromagnetic ratio of the 4$^+$ state of Ce-140, 18: 21286

WILSON, V. C., Analysis of parallel plane Cs thermionic converter, 18: 20855

WINCHELL, H. S., Beta irradiation of dog lymphatic structures, 18: 19601

WINCHELL, H. S., Radiation-induced hemorrhagic diathesis in dogs, 18: 19600

WINCHESTER, John W., Chromatographic columns for rare-earth separation, 18: 20109

WINDEYER, B. W., Radiations, radiologists, and the human race, 18: 19625

WINTERBERG, F., Attainability of fusion temperatures by small solid particles accelerated to hypervelocities, 18: 21418

WISE, Edward N., Prog. rpt. on coulometric analysis of rare-earth elements, 2/63–2/64, 18: 19851 (TID-20548)

WITKOWSKI, S., Measurements of a stationary d-c He arc, 18: 21484

WITTING, Herold L., Volume ionization processes in Cs converters, 18: 20850

WLODEK, St., Radioactivity of water in Poland, 1962, 18: 20211 (CLOR-24)

WLOTZKA, F., Production cross sections for He-3 and Ne-21 from stone meteorites, 18: 20204

WOERNER, W., Spectroscopic investigation of thermionic converter, 18: 20854

WOESSNER, D. E., Molecular reorientation in liquids, 18: 19962

WOISCHNIG, W., Electron-photon cascades according to Monte Carlo method, 18: 21322

WOLFGANG, Richard, Studies of reactions of atomic C, 18: 20022 (CONF-322-10)

WOLICKI, Eligius A., Ray-tracing method for ion-optical measurements, 18: 21022

WOLLMAN, H., Krypton-85 uptake of the human brain, 18: 19522

WOLMARANS, N. S., Use of ferrite memory cores, 18: 20371

WOLSKI, M., Radiological protection in flaw detection, 18: 20259

WONG, K. W., System of hard-sphere Bose gas, 18: 21028

WONG, Madeline, Properties of Be compounds. V., 18: 19969

WOOD, J. D. L. H., Pulsed neutron source for reactor measurements, 18: 21605

WOOD, T. H., Effects on genetic recombination of *E. coli* K-12 produced by x-ray and α-particle irradiation of the female, 18: 19620

WOOD, Vida G., Effect of x radiation on longevity in *Drosophila melanogaster*, 18: 19554 (TID-20550)

WOODWARD, V. W., Neurospora mutants lacking ornithine transcarbamylase, 18: 19621

WOODYARD, James R., Neutral Cs and Cu, sputtered from polycrystalline Cu, 18: 20811

WOOL, Ira G., Effect of insulin on accumulation of radioactivity from amino acids, 18: 19540

WOOLES, W. R., Palmitate-1-C^{14} metabolism in the rabbit, 18: 19665

WOOLLETT, Richard R., Electromagnetic wave propagation in cold, collisionless H plasma, 18: 21381 (NASA-TN-D-2071)

WOOLLETT, Richard R., Existence of waves in cold, collisionless hydrogen plasma, 18: 21382 (NASA-TN-D-2273)

WOOLSEY, G. A., Constriction in positive column, 18: 21462

WORRELL, Wayne L., Entropy of formation for some refractory metal carbides, 18: 19974

WORRELL, Wayne L., Free energies of formation of V, Nb, and Ta carbides, 18: 19970

WORRELL, Wayne L., Free energy of formation of NbO_2, 18: 19973

WORSHAM, H. J., Jr., Design of cooling system for pool reactor, 18: 21688

WRIGHT, J. S., Determination of traces of U, 18: 19900

WRIGHT, R. W., Pressure pulses in rapid transient boiling, 18: 21549 (CONF-187-111)

WRIGHT, W. B., Analysis of multicell networks, 18: 20884

WRIGHT, W. J., Mechanical testing of BeO, 18: 20573

WRIGHT, W. J., Performance of BeO in H.T.G.C. reactor, 18: 21660

WRONSKI, A., Deformation mechanisms in Nb, 18: 20543

WU, C. S., Conserved vector current in β decay, 18: 21306

WU, Cheng, Initial leucocytosis after γ irradiation, 18: 19697

WU, Shi T., Water-cooled solenoid for a plasma, 18: 21539

WU, Te-yao, Thermal conductivity of fully ionized gas, 18: 21397

WUEHRMANN, A. H., X radiation in dental offices. III., 18: 20261

WUEST, Paul Joseph, Study of *M. hapla* eggs as affected by uv radiation, 18: 19759

WUKUSICK, C. S., Intermediate-temperature behavior of Cb–Al alloys, 18: 20474 (TID-12794)

WUNG, Pei-kung, Beta spectrometer with intemediate image, 18: 20405

WYLIE, Robert D., Prog. rpt. on evaluation of Elk River reactor pressure vessel, 10–11/63, 18: 20528 (SWRI-1228-18)

WYLIE, Robert D., Prog. rpt. on evaluation of Elk River reactor pressure vessel, 12/63–1/64, 18: 20457 (SWRI-1228-19)

Y

YABE, Akira, Fallout radioactivity in excreta and diet in Japan, 1962–63, 18: 20232 (JAERI-1057)

YAENO, Koi, Effect of x irradiation on Zn-65 metabolism in liver of mice, 18: 19531

YAGI, Eiichi, Corrosion-resisting films of Ti and Zr, 18: 20481

YAKIMETS, V. V., Effect of quantum absorption on bremsstrahlung of ultrarelativistic electrons, 18: 21334

YAKOVLEV, V. I., Interactions of expanding plasma cylinder with external magnetic field, 18: 21427

YAKUBENKO, A. E., Conducting fluid flow in plane channel, 18: 20659

YAKUBOV, I. T., Radiation cooling of gas heated by shock wave, 18: 21408

YAMADA, Hiroyuki, Corrosion-resisting films of Ti and Zr, 18: 20481

YAMADA, Y., Polonium in urine of Japanese U miners, 18: 19916

YAMAGISHI, Herve, Nuclear magnetic resonance in ScN and VN, 18: 19980

YAMAGISHI, Shigeru, Behavior of several elements in fused Bi-fused salts system. II., 18: 19983
YAMAMOTO, Kazuo, Preparation of U carbides, 18: 20493
YAMAMOTO, Kunio, Strong shrinkage of the effective core at high energy, 18: 21043
YAMAMOTO, Tsutomu, Myelofibrosis with myeloid metaplasia in survivors of Hiroshima, 18: 19568
YAMAMOTO, Yonezi, Transplantability of Yoshida ascites tumor cells. I., 18: 19651
YAMASHITA, T., CdS γ-ray detector, 18: 20351
YAMAZOE, Masao, Improvements in valves, 18: 20199
YANAGISAWA, Hifumi, Comparisons of nuclear characteristics between circular and rectangular core cell, 18: 21604
YANAI, Mieko, Determination of Zr with flavonol-2'-sulfonic acid, 18: 19884
YANG, Gee-zhen, Intermediate boson theory of weak interaction, 18: 20973
YANG, L., Compatibility of U fuels and thermionic emitters, 18: 20874
YANKE, B., Measuring by means of proton magnetometer, 18: 20288
YANKOVSKII, Yu., Measuring by means of proton magnetometer, 18: 20288
YASUI, Junichi, Corrosion-resisting films of Ti and Zr, 18: 20481
YASUOKA, Hiroshi, Nuclear magnetic resonances of Fe-57 and Mn-55, 18: 19979
YAVOR, S. Ya., Achromatic quadrupole lenses, 18: 20686
YBARRA, R. M., Large SGR fuel handling, 18: 21638 (NAA-SR-Memo-8266)
YEH, Hsuan, Longitudinal variation of MHD channel cross section for maximum power, 18: 20836 (R61SD066)
YEN, James T., Magnetoplasmadynamic channel flow, 18: 21410
YIFTAH, S., Inelastic scattering matrices for fast reactor calculations, 18: 21598 (IA-899)
YILDIZ, M., Excitation of waves in plasma, 18: 21396
YODH, G. B., Reactions $\pi + N \rightarrow \pi_1 + \pi_2 + N'$ from threshold to 700 Mev, 18: 20915 (TID-20490)
YOKORO, K., Role of lymphoma virus in x-ray induction of myeloid leukemia, 18: 19578
YOKOTA, Masahiro, Deformation of theta-pinched plasma, 18: 21402
YORK, C. M., Liquid-H Cherenkov counter, 18: 20369
YOSHIDA, Hiroyuki, Spectrophotometric determination of rare earth elements in Th by xylenol orange, 18: 19883
YOSIM, S. J., Heat capacities and compressibilities of liquids, 18: 19929 (CONF-417-20)
YOUNG, D. A., Evaluating defects in graphite, 18: 20542
YOUNG, J. C., Delayed γ rays from photofission of U-238, U-235, and Th-232, 18: 21298
YOUNGBLOOD, James Luther, Plastic deformation of Mo single crystals, 18: 20563
YU, Kwang, Diffusion of small particles in nonuniform atmosphere, 18: 20620

Z

ZABLOVSKII, E. E., Observation of effects of light and field on semiconductors, 18: 20307
ZACHARIAS, Bengt, Effect of irradiated N gas on N fixation by Azobacter, 18: 19721
ZAEHRINGER, J., Primordial rare gases and Xe-129 in meteorites, 18: 20726
ZAGER, B. A., Resonance h-f electric discharge and possibilities of depressing it, 18: 20663
ZAHN, U., Beta decay energy of Tc isotopes, 18: 21319
ZAIMIDOROGA, O. A., Helium-3 for filling high-pressure diffusion chamber, 18: 20390
ZAITSEV, K. G., Measuring ionization losses of relativistic particles in emulsions, 18: 20391
ZAITSEV, V. V., Theory of nonstationary, multiple Compton scattering of γ quanta, 18: 20920
ZAKAY-RONESS, Z., Effect of uv-irradiated inactive vaccinia virus on development of Shay leukemia in rats, 18: 19614
ZAKHARIEV, B. N., Resonance density in scattering on bound particles, 18: 20906 (JINR-P-1562)
ZAMCHUK, L. A., Effects of γ radiation on autotrophic mutants of *coliform bacterium,* 18: 19688
ZAMICK, Larry, Spectroscopy in the nuclear $1f_{7/2}$ shell, 18: 21275
ZAMORI, Z., Gamma-γ angular correlation in $Ni^{60}(n,\gamma)Ni^{61}$ reaction, 18: 21240
ZANNONI, G., Decay of Sn-133, 18: 21267
ZANNONI, G., Polarization of protons scattered from C-12, 18: 21300
ZANON, S. C., Electrical breakdown between sphere and plane in vacuum, 18: 20138
ZASLAVSKII, G. M., Turbulent diffusion of weakly ionized plasma, 18: 21425
ZASLAWSKY, Maurice, Viscoelasticity of polymers, 18: 20531 (UCRL-7255)
ZEBRO, Tadeusz, Resistance of C_{57} black mice to irradiation leukemia, 18: 19663
ZEBRUN, William, Effects of x irradiation on fine structure of HeLa cells, 18: 19723
ZEHENDER, Otto, Gamma radiation from thermal neutron capture in Se-77, 18: 21329
ZEITOUN, A., Study of prebreakdown discharge, 18: 20145
ZELDIS, L. J., ABCC-NIH studies of carcinogenesis in Hiroshima and Nagasaki, 18: 19580
ZELEZNY, William F., Design of corrosion and chemical control test loop, 18: 21565 (IDO-16812)
ZEMAN, Adolf, Chelating radiometric titrations, 18: 19899
ZENKEVICH, B. A., Data on critical heat flux in forced water flow, 18: 20190
ZERDIN, F., Anisotropy of diffusion constant in media with empty channels, 18: 21141
ZHDANOV, G. B., Current development of emulsion method, 18: 20901 (CERN-64-6(p.125-42))
ZHESTYANIKOV, V. D., Radioresistance of *E. coli* cultivated under γ irradiation, 18: 19686
ZHESTYANIKOV, V. D., Restoration of *E. coli* irradiated under various conditions, 18: 19681
ZHEZHERUN, I. F., Effect on thermal diffusion length of empty channels in the moderator, 18: 21602
ZHILEIKO, G. I., Power balance equation in linear electron accelerator, 18: 20683
ZHUKHOVITSKII, E. M., Sphere rotation in viscous conducting fluid in magnetic field, 18: 20664
ZIEGLER, W. T., Vapor pressure and heats of vaporization of CO and CO_2, 18: 19933 (NP-13862)
ZIELINSKA, M., Binding energy of α particle with velocity-dependent potential, 18: 20912 (PAN-468/VII)
ZIEMER, P. L., Analysis of organically bound I, 18: 19877
ZIFFERERO, M., Influence of nitrates on HNO_3 by long-chain amines, 18: 20107
ZIMIN, E. P., Conducting fluid in plane MHD channel, 18: 20660
ZIMMER, K. G., Experiments in radiation chemistry of T1-phage, 18: 19634
ZIMMERLI, T., Determination of L-fluorescence yield of Dy, 18: 21320
ZINK, J. W., Concerning quantization of flux, 18: 21097 (UCRL-7308-T)
ZIPF, T. F., Liquid-H Cherenkov counter, 18: 20369
ZITTEL, H. E., Titration of Cr in mixtures of fluoride salts, 18: 19869
ZITTEL, H. E., Voltammetry of Ce(IV), Mn(VII), Cr(VI), and V(V), 18: 19967
ZMORA, H., 26.8-Kev state of I-129, 18: 21238
ZOELLER, O., Inhomogeneous thermal plasma column, 18: 21469
ZOGRAPHOV, Dimiter G., Influence of anemic blood plasma on effectiveness of bone marrow transplantation, 18: 19804
ZOLOTAREV, V. S., Electromagnetic separation of Os isotopes, 18: 20432
ZOSIMOVSKAYA, A. I., Mitosis and interkinesis in mouse tissues, 18: 19609
ZSEBOEK, Zoltan B., Extracellular water space changes in intestinal radiation death, 18: 19718
ZWEIG, Hans Jacob, Counter models and applications, 18: 20415
ZWICK, J. W., Neutron cross sections for Ta, 18: 21170 (GEMP-279)
ZWICK, J. W., Nine- and sixteen-group cross sections for W, 18: 21168 (GEMP-223)
ZWICKER, H., Thermal energy density in confined plasmas, 18: 21532
ZWICKER, Hartmut, Pinch effect at high gas density, 18: 21419
ZWICKER, Hartmut, Spectroscopic investigation on magnetically compressed plasma, 18: 21421
ZYKOV, A. I., Optimum frequency shift in injector accelerator, 18: 20705

SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

A

ABSORPTION
of cesium-137 by rats, effects of ferric ferrocyanate(II) on, 18: 19534
ABSTRACTS
of 11th International Conference on Spectroscopy, 18: 20676
on chemical detectors, 18: 19847 (LAMS-2378(Vol.II))
ACCELERATORS
beam energy homogeneity for, method for obtaining, 18: 20706
beam focusing system for, 18: 20704
beam phase oscillation in, effects of external interference on, 18: 20700
beam phase oscillations in, harmonic linearization of, 18: 20701
beam separators for, multiplate electrostatic, 18: 20680 (NIRL/R/49)
control of, use of multiplex techniques in remote, 18: 20280 (CERN-64-21)
design for acceleration of heavy ions, 18: 20699
development in Western Europe, 18: 20697
development of, review, 18: 20693
frequency shift in injector, 18: 20705
ion source for 1-Mev, 18: 20691
plasma behavior in crossed-field, 18: 21442
plasma, theory of cross-field, 18: 20129 (ARL-64-29)
radiation effects on interior targets in circular, 18: 20687
ACETAMIDE
radiolysis of, formation of carbon-14-labeled compounds in neutron, 18: 20092
ACETAMIDE, 2-CYANO-
radiolysis of, formation of carbon-14-labeled compounds in neutron, 18: 20092
ACETAMIDINE
radiolysis of, formation of carbon-14-labeled compounds in neutron, 18: 20092
ACETATES
radiation effects on uptake of, by lipids in human bone marrow, 18: 19552(R) (NYO-2769-1)
ACETIC ACID, [(CARBOXYMETHYLIMINO) BIS(ETHYLENENITRILO)] TETRA-
effects of, on delayed removal of plutonium-239 from rats, 18: 20236(R) (PG-Report-565)
lymph system irradiation in dogs using yttrium-90-labeled, 18: 19601
yttrium-90-labeled, hemorrhagic diathesis induction in dogs by, 18: 19600
ACETIC ACID, (ETHYLENEDIAMINE) TETRA-
analytical uses for determination of cobalt and indium by radiometric titration, 18: 19899
ACETIC ACID, IODO-
effects on radiosensitivity of *Micrococcus radiodurans*, 18: 19751
radiation effects on color of starch mixture and use as chemical dosimeter, 18: 19751
ACETONE
yields in radiolysis of aqueous solutions of propanol containing nitrous oxide, 18: 20058
ACETONE, THENOYLTRIFLUORO-
solvent properties for neptunium, plutonium, and uranium, 18: 19896
ACETOPHENONES
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
ACETYLENE
electric discharge in, secondary ionization in, 18: 20137
phenyl-, radioinduced polymerization of, gamma, 18: 20052
ACRIDINES
radiolysis of solid solutions of, gamma, 18: 20094
ACRYLAMIDE
acrylamide-propionamide, radiolysis of solid solutions of, yields of decomposition products in gamma, 18: 20094
ACRYLIC ACID, β-CYANOETHYL ESTER
radioinduced copolymerization with ethyl vinyl sulfone, 18: 20450(R) (BMI-1661(Del.))
ACRYLONITRILE POLYMERS
radioinduced graft polymerization with cotton, thermal stress properties of products in, 18: 20084
ACRYLONITRILES
radioinduced graft polymerization onto polystyrene, 18: 20096(R)
ACTIVATION ANALYSIS
developments in, review of, 18: 19867
method for determination of 62 trace impurities in aluminum, beryllium, 18: 19876
of biological materials, interference between sodium-24 and copper-64 in, 18: 19841 (CONF-187-112)
of commercial lubricating oils, computer routines for, 18: 19918
optimum irradiation and decay times in, computer program for determination of, 18: 19874
sample position relative to radium-beryllium neutron source, optimum, 18: 19906
substoichiometric method for trace metals, 18: 19852 (UJV-992/63)
uses of, review of, 18: 20044
ADAMANTANE
radical anion formation in saturated, 18: 19837(R) (MIT-905-1)
ADENOSINEPHOSPHORIC ACIDS
radioprotective effects on rat lungs, gamma, 18: 19807
ADHESIVES
electric conductivity of polysulfide-epoxy, 18: 21707(R) (MLM-1177)
electric conductivity of polysulfide-based, 18: 21709(R) (MLM-1179)
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
tensile properties of silicone and polyurethane, 18: 21707(R) (MLM-1177)
ADIPIC ACID, 1,6-HEXANEDIAMINE SALT
radiation effects on ESR spectra of single-crystal, 18: 20075
ADRENAL GLANDS
radiation effects on activity of acid phosphatase esterases, and lipids in guinea pig, 18: 19710
ADRENAL HORMONES
tritium label stability in, 18: 19543
ADRENALINE
effects of, on radiation effects on oxygen consumption by rats, 18: 19742
radioprotective effects of, mechanism for, 18: 19771
ADVANCED TEST REACTOR
loop connector testing, 18: 21681 (HW-80680)
AEROSOLS
radioactive, preparation and use for testing filter efficiency, 18: 20239(T) (NP-tr-1124)
AGE ESTIMATION
of carbonates by fission damage in calcite, 18: 20224
AGING
effects on calcium-45–strontium-90 discrimination in miniature pigs, 18: 19539
radiation effects on hamster, x, 18: 19672
role of, in carcinogenesis, 18: 19505 (BNL-7912)
AGRICULTURE
soil management practices, effects on nutrient assimilation by plant roots, 18: 19515 (NP-13796)
AIR
analysis for carbon dioxide, use of coaxial symmetrical flow spark counter for, 18: 20348
analysis for thoron, development of direct method for, 18: 19893
electric breakdown in parallel plate electrode geometries, model for, 18: 21492
electric breakdown in, stages of, 18: 20146
electric breakdown in plane-point and plane-wire gaps, 18: 20148
electric discharge in, formative time lags in, 18: 21493
electric discharge in uniform field gaps, cathode and humidity effects on, 18: 20602
electric discharge in, photon absorption in, 18: 21474
electromagnetic wave propagation in, electron radiation effects on, 18: 20618(R) (NP-13799)
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
introduction into cobalt-60 irradiation facility, 18: 20419
radiation effects on static breakdown voltage in, 18: 20602
separation from water, development of centrifugal separators for, 18: 20128(R) (ACNP-64021)
spectra in mixtures with deuterium, negative ions in afterglow, 18: 21093
spectra of, negative ions in afterglow, 18: 21093
air–Ar, electric breakdown in plane-point and plane-wire gaps, 18: 20148
ALANINE

separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
synthesis of carbon-14-labeled α-DL-, 18: 20033

ALANINE, PHENYL-
photochemical reduction to phenylethylamine in aqueous solutions, 18: 20081

ALASKA
radionuclide concentrations in human inhabitants of, 18: 20231 (HW-SA-3048)

ALBUMINS
preparation of labeled colloidal aggregates of blood serum, for use in pathema localization by photoscanning, 18: 19813 (CONF-164-11)
radiation effects on synthesis of, 18: 19688
radiation effects on, in animals irradiated at 3270 to 5400 r, 18: 19703

ALCOHOLS
mass spectra of excess-kinetic-energy ions in, 18: 20026

ALKALI METAL CHLORIDES
spectra of, pure rotational, 18: 19990

ALKALI METAL HALIDES
color centers in crystals of, 18: 20622 (COO-1044-16)
electron beam reactions with, distribution of absorbed energy from, 18: 20043

ALKALI METALS
reflection properties of plasma in, 18: 21047

ALKANES
mass spectra of excess-kinetic-energy ions in, 18: 20026

ALKENES
book: *Crystalline Olefin Polymers*, 18: 20034
isotope effects on acid-catalyzed hydration, determination by calculation of vibrational frequencies of transitional states, 18: 19952
mass spectra of excess-kinetic-energy ions in, 18: 20026

ALLANITES
alpha activity and thorium concentration in, in Conway granite, 18: 20222

ALLENES
formation by carbon atom reactions with ethylene, mechanism of, 18: 20022 (CONF-322-10)

ALLOYS
analysis for rare earths, gravimetric, 18: 19909
bibliography on liquid, 18: 20444 (AD-417111)
diffusion in, book, 18: 20536(T) (AEC-tr-6313)
oxidation of, design of apparatus for measuring weight changes in, 18: 20480

ALPHA DECAY
theory of, bibliography on, 18: 21353

ALPHA PARTICLES
attenuation by diamonds, 18: 20746
attenuation by silicon semiconductor detectors, 18: 20376
binding energy and radius of, variational calculation of, 18: 20912 (PAN-468/VII)
chemical effects on toluene at 0.7 and 1.5 Mev, relation of linear energy transfer and yields in, 18: 20055
detection and measurement using nuclear emulsions, 18: 20362
detection and measurement in ionization chambers, energy resolution for, 18: 20393
detection and measurement from neutron reactions with uranium-238, design of instrument for, 18: 20403
detection and measurement using silver halide nuclear emulsions, 18: 20414
dosimetry of, formulas for, 18: 20262
effects on blood picture in goldfish, 18: 19756
effects on *E. coli* genetic recombination after female irradiation, 18: 19620
effects on human kidney cells, methods for modification of, 18: 19760
emission in spontaneous fission of curium-244, 18: 21222
reactions (α,an), (α,a2n), (α,ap), and (α,apn) with nickel-58 at 46 to 68 Mev, recoil ranges of product ions in, 18: 21294
reactions (α,He^3) and (α,t) with nuclei, nuclear spectroscopy using, 18: 21204 (LADC-6302)
reactions (α,n) with rubidium-87 at 11 to 18 Mev, isomer production in, 18: 21279
reactions (α,pγ) with fluorine-19 at 4.7 to 5.5 Mev, angular correlations in, 18: 21246
reactions in liquid helium, scintillation, 18: 20756
reactions with anthracene and *p*-terphenyl, effects of thickness on rotation of light from, 18: 20409
reactions with scintillators, pulse-height ratios for comparison with electrons, 18: 20408
scattering by carbon-12, Regge poles and resonance in, 18: 21332
scattering by carbon-12, nitrogen-14, and oxygen-16 at 65 Mev, 18: 21260
scattering by copper at 4 to 8 Mev, coulomb excitation in, 18: 21281
scattering by copper, iron-54, and nickel at 7 to 12 Mev, angular distributions from elastic, 18: 21292

ALPHA SOURCES
design of polonium, variation of window spacing in, 18: 21707(R) (MLM-1177)
fabrication of large-area plated, 18: 21707(R) (MLM-1177)
preparation of uranium, electrolytic, 18: 20422

ALPHA SPECTROMETERS
performance of, using silicon surface-barrier detectors, 18: 20354
performance of, using silicon surface barrier detectors, 18: 20355

ALUMINUM
analysis of high-purity, activation, 18: 19876
bonding to uranium cores, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
cosmic-ray reactions above 10 Bev, 18: 21207 (NP-13839)
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in silicate rocks, quantometric and spectrogmphic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
effects on spalling of niobium at high temperatures, 18: 20474 (TID-12794)
effects on superconductivity of niobium–tin alloys, 18: 21110
electron range-energy relation in, semi-empirical, 18: 20929
electron reactions with, electron pair production in, 18: 21311
electroplating with lead, 18: 20134(R) (ORNL-TM-792)
fission products in, from thermal-neutron-induced fission of uranium-235, 18: 19837(R) (MIT-905-1)
hydrogen ion reactions at 260 kev, uv radiation emission in, 18: 20781
neutron resonance scattering by, 18: 21698(R) (ANL-6860)
neutron total cross sections at 2.77 Mev, 18: 21159 (CEA-2399)
pinch discharge on foils of, plasma production in Z, 18: 21537
plastic recovery of cold-worked, role of dislocations in, 18: 20533 (UCRL-10728)
proton reactions (p,n) at 6 Bev, 18: 21698(R) (ANL-6860)
proton reactions at 260 kev, uv radiation emission in, 18: 20781
proton scattering by, x-ray emission in, 18: 20734(T) (UCRL-Trans-1050(L)
radiography of thin, ytterbium-169, 18: 20425
reflectance of crystalline, 18: 19837(R) (MIT-905-1)
shielding properties, 18: 21543 (BMI-1384)
spectra of, vibration, 18: 21121 (BNL-7958)
sputtering by argon and nitrogen at 0.5 to 4 kev, momentum accommodation in, 18: 20782
stacking-fault energy, 18: 20550
welding for reactor construction, gas-torch and WIG-, 18: 20490

ALUMINUM ALLOYS
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
oxidation by water at 315°C, 18: 21706(R) (KR-66)
spalling of coatings of, on niobium at high temperatures, 18: 20474 (TID-12794)
Al–Cr–Ni–Ti, corrosion of Inconel 702 by superheated steam, 18: 21668(R) (GEMP-274)
Al–Mg, corrosion of, effects of indium on, 18: 20482
Al–Mn–Th, phase studies of $ThAl_2$–$ThMn_2$, 18: 20554
Al–Mo, phase diagram, 18: 20549
Al–Nb, spalling at high temperatures, 18: 20474 (TID-12794)
Al–Ni–Nb, oxidation rate of Ni_2Al–Ni_2Nb, 18: 20478
Al–Pu, reactivity of fuel elements of, 18: 21613 (HW-79960)
Al–Ti, transformation characteristics during continuous cooling,

18: 20545
ALUMINUM CHLORIDES
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
$AlCl_3$–$BeCl_2$, phase diagram, 18: 19950
ALUMINUM IONS
spectral locations and widths in plasma, 18: 21409(T)
ALUMINUM ISOTOPES Al-24
beta decay, 18: 21306
beta decay of, circular polarization of gamma radiation following, 18: 21309
beta decay of, meson exchange effects in gamma circular polarization following, 18: 21269
ALUMINUM ISOTOPES Al-26
beta decay of excited, half life for, 18: 21306
determination in iron meteorites, 18: 20221
ALUMINUM ISOTOPES Al-27
deuteron reactions (d,He^3) with, analysis of, 18: 21204 (LADC-6302)
deuteron reactions (d,α) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
energy levels of, gamma transitions in low-lying, 18: 21256
meson (π^-) spallation reactions at 0.45 to 1.8 Bev, cross sections for carbon-11–fluorine-18 production in, 18: 21293
proton reactions (p,α) at 9 to 12 Mev, cross-section fluctuations in, 18: 21237
ALUMINUM ISOTOPES Al-28
beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
ALUMINUM NITRATES
effects on separation of nitric acid from aqueous solutions by solvent extraction using long-chain amines, 18: 20107
ALUMINUM OXIDES
additive effects on fabrication and properties of tungsten, 18: 20443(R) (AD-416199)
corrosion by cesium at 750°C, 18: 20873
deposition of coatings of, on fuel particles, 18: 20450(R) (BMI-1661 (Del.))
deposition on thorium(IV) oxide and uranium(IV) oxide particles, 18: 20570
diffusion of xenon-133 in, 18: 20570
fission gas release from coatings of, 18: 20450(R) (BMI-1661(Del.))
nuclear magnetic resonance of sorbed hexafluoropropene on, temperature dependence of, 18: 20632 (TID-18689)
performance of cesium-coated, as collector for thermionic cells, 18: 20870
phase transformation kinetics in, liquid-solid, 18: 20534 (UCRL-11166)
radiation effects on thermal control coatings of, in nuclear spacecraft, 18: 20603
sorptive properties for boric acid from solutions, 18: 21565 (IDO-16812)
sorptive properties for protactinium, 18: 20105
AMERICIUM
separation from neodymium and promethium by ion exchange, 18: 21707(R) (MLM-1177)
separation from plutonium by ion exchange, 18: 20459(T,R) (EURAEC-954)
separation from promethium, 18: 21708(R) (MLM-1178)
AMERICIUM ISOTOPES Am-241
alpha spectra, 18: 20376
scintillator quenching by, 18: 20352
AMERICIUM ISOTOPES Am-242
gamma spectra of isomeric, 18: 20376
AMIDINES
nitro-, protective effects against radiation in rats, 18: 19782
AMINES
hexamethylenetetra-, radical anion formation in saturated, 18: 19837(R) (MIT-905-1)
photochemical production of, effects of hydrogen peroxide, oxygen, and reducing agents on, 18: 20081
separation by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
solvent properties for nitric acid, 18: 20107
AMINO ACIDS
radiation effects on urinary excretion of, in man, 18: 19638
radioinduced polymerization by fast electrons, 18: 20074
separation by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
AMMONIA
ion exchange behavior in, 18: 21712(R) (NYO-10065)
AMMONIUM CHLORIDES
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
NH_4Cl–glucose, effects of irradiated, on *Pseudomonas sp.*, 18: 19627
AMMONIUM COMPOUNDS
with hafnium fluorides, electric hyperfine structure interactions in, 18: 21321
AMMONIUM IONS
tetrabutyl-, solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)
AMMONIUM NITRATES
properties for use in chemical radiation dosimetry, 18: 20080
radiation effects on, 18: 20080
AMMONIUM PEROXYDISULFATES
reactions with uranium dioxide, effects of halides on, 18: 19943
AMMONIUM ZINC SULFATES
radioinduced vanadium ions in, spectra of, 18: 20059
vanadyl ion growth in, spectra of, 18: 20059
AMOEBA
radiation effects on, restoration of lethal, 18: 19637
AMPHIBIANS
radiation effects on gastrulas of, x, 18: 19649
AMPLIFIERS
design of fast-coincidence pre-, for solid-state detectors, 18: 20356
design of low-noise, for semiconductor detectors, 18: 20366
ANESTHESIA
effects on krypton-85 and nitrous oxide uptake by human brain, 18: 19522
radiation effects on animals in, x, 18: 19612(T)
ANILINE, N, N-DIMETHYL-
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
ANILINE, N-ETHYL-
preparation by photochemical reduction of phenylalanine, 18: 20081
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
ANIMAL CELLS
effects of heavy ions on, 18: 19571
generative cycle in neoplastic, 18: 21701 (BNL-7925)
proliferation of bone marrow, 18: 19509
protective effects in mice of homologous bone marrow and spleen, 18: 19767
radiation effects on growth of, in regenerating tissues in salamanders and mice, 18: 19553(R) (TID-20513)
radiation effects on mammalian tumor, 18: 19572
radiation effects on HeLa, from tritiated-thymidine or -uridine uptake, beta, 18: 19644
radiation effects on transplantability of ascites tumor, 18: 19651
radiation effects on hamster lung, x, 18: 19670
radiation effects on transplanted lymphoma, assay method for gamma, 18: 19671
radiation effects on, relative γ and x, 18: 19685
radiation effects on stem cells in mice, effects of erythropoietin on, 18: 19635
radiation effects on transplants of mouse, 18: 19591
radiation effects on tritiated cytidine uptake by HeLa, x, 18: 19599
radiation effects on human marrow, gamma and neutron, 18: 19602
radiation effects on enzyme activity of, in and surrounding carcinoma, 18: 19701
radiation effects on HeLa, x, 18: 19723
radiation effects on mouse, wavelength-dependent, 18: 19757
radiation effects on human kidney, methods for modification of, alpha, beta, deuteron, gamma, and x, 18: 19760
radiation effects on mouse hematopoietic, repair of gamma, 18: 19761
radiation effects on L-strain, restoration of viability following, using isologous subcellular fractions, 18: 19783
radioinduced aberrations in cultures of human skin, x, 18: 19563
radioprotective effects of PVP-preserved mouse bone marrow and spleen,

18: 19778
radiosensitivity of bone marrow, in rats, 18: 19660
radiosensitivity of, in normal and neoplastic tissues, 18: 19802
separation of bone marrow, technique for, 18: 19525
uptake of tritium-labeled thymidine and uridine by hamster, effects on cell death, 18: 19645
ANIMAL REPRODUCTION
radiation effects on, in rabbits, gamma, 18: 19755
ANIMALS
cesium-137 and strontium-90 in Lapland, 18: 20213
radiation effects on mortality of small, proton, 18: 19812 (BNL-6966)
radiation effects on blood count and protein in, 18: 19703
radioinduced castration in, effects on hematopoietic system, 18: 19731
vanadium isotopic ratio in *Ascidia ceratodes* and *Ciona intestinalis*, 18: 19519 (IS-655)
ANIONS
reactions with atoms, electron detachment in, 18: 20771
spectra of, in afterglow in atmospheric gases, 18: 21093
ANISOLE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
ANISOLE, *o*-IODO-
isotopic exchange with iodine, effects of butoxide, chloride, and tin ions on, 18: 19964
ANODES
electron reactions with Penning-discharge, x-ray spectra from, 18: 21502
vaporization in vacuum electric breakdown, 18: 20142
ANP REACTORS
control characteristics, 18: 21561 (APEX-603(DeL))
ANTHRACENE
alpha and electron excitation of, pulse-height ratios for, 18: 20408
alpha excitation of, effects of thickness on rotation of light from, 18: 20409
radiolysis of solid solutions of, gamma, 18: 20094
ANTHRACENE, DIPHENYL-
spectra of solutions of, beta and uv excitation, 18: 20046
ANTIBIOTICS
effects of, combined with radiation on scale homograft survival in fish, x, 18: 19726
protective effects against human radiation injury, 18: 19763
ANTIBODIES
effects of cytotoxic agents on human production of, 18: 19523
radiation effects on formation of, in rabbits, effects of antigen injection on, 18: 19735
radiation effects on rabbit production of *Bacterium paratyphosum*, x, 18: 19738
radioinduced production in rabbits and rats, x, 18: 19722
ANTIFERROMAGNETIC MATERIALS
superconductivity, 18: 21103
ANTIGENS
effects of administration of, on radiation effects on rabbit antibody formation, 18: 19735
radiation effects on mouse transplantation, x, 18: 19589
ANTIHYPERONS
production in proton-antiproton collisions, unitary symmetry model for, 18: 20953
ANTIMONY
analysis for antimony-122 and -124, calculation method for, 18: 20069
determination using pyrogallol, 18: 19855(T) (UCRL-Trans-1011(L))
effects on superconductivity of niobium–tin alloys, 18: 21110
effects on thallium superconducting transition temperature, 18: 21113
separation from arsenic by pyrogallol precipitation, 18: 19855(T) (UCRL-Trans-1011(L))
separation from fission products, radiochemical, 18: 19837(R) (MIT-905-1)
ANTIMONY ALLOYS
Sb–Cs, performance as collector for thermionic cells, 18: 20870
Sb–Ga, photoelectric and sorptive properties, 18: 20564
ANTIMONY ISOTOPES Sb-125
content in plants and soils, 18: 19516
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
ANTIMONY OXIDES
sorptive properties for protactinium, 18: 20105
ANTINEUTRONS
annihilation electron showers from, 18: 20928
production in proton-antiproton collisions, unitary symmetry model for, 18: 20953
ANTIPARTICLES
scattering by nuclei at high energies, differential cross sections for, 18: 21333
ANTIPROTONS
interactions with protons, unitary symmetry model for, 18: 20953
ARABINOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
ARGININE
uptake of tritium-labeled, by *Vicia faba* root meristem cells, 18: 19518 (BNL-7007)
ARGON
compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
compressibility of solid, 18: 19929 (CONF-417-20)
diffusion coefficients in carbon tetrachloride, 18: 19963
effects on radiolysis of carbon monoxide, 18: 20087
electric breakdown in plane-point and plane-wire gaps, 18: 20148
electric discharge in, impedance characteristics of d-c, 18: 21457
electric discharge in, impedance of, 18: 21459
electric discharge in, ion motion in, 18: 21488
electric discharge in, properties of stabilized, 18: 21498
electric discharge in, atom and electron densities in r-f, 18: 21512
electric discharge in, properties of r-f, 18: 21517
electron multiple scattering at 40 to 130 kev, linear displacement distributions in, 18: 21316
electron scattering at 25 kev, cross sections for and optical transitions in, 18: 20764
electron vacancies in, readjustment to inner, 18: 20729 (CONF-481-6)
interactions with helium and xenon atoms, dipole-quadrupole and retardation effects on cross sections for elastic, 18: 20733 (WIS-TCI-41)
ionization by electrons, cross sections for, 18: 20768
lithium-7 scattering at 7 to 60 kev, angular distributions from, 18: 21318
performance in low-voltage thermionic diodes, 18: 20851
pinch discharge in, axial streams in Z, 18: 21531
pinch effect in, effects of high initial pressure on, 18: 21419
plasma of, properties of, 18: 21368 (AFCRL-63-161)
plasma of, radiation cooling of, 18: 21408(T)
plasma of, stability of a-c positive column of, 18: 21412
purification of, design of equipment for, 18: 20830(R) (AD-432464)
radioinduced ionization in thermionic cells, fission-fragment, 18: 20860
reactions with argon, neon, and oxygen ions, method for studying interchanges in, 18: 20021
scattering of potassium chloride molecules by, 18: 20627(R) (NP-13815)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
thermal capacity of solid, 18: 19929 (CONF-417-20)
thermionic properties in diodes, 18: 20831 (APL-TDR-64-28)
ARGON IONS
ionization of monovalent, by electrons, cross sections for, 18: 20768
reactions with argon and nitrogen, method for studying interchanges in, 18: 20021
reactions with crystal surfaces at 4 to 100 ev, Auger electron yield in, 18: 20780
reactions with molecules at 15 to 200 ev, charge exchange in, 18: 20742
sputtering on copper at 20 to 100 ev, atomic and diatomic yields in, 18: 20811
sputtering on metals at 0.5 to 4 kev, momentum accommodation in, 18: 20782
sputtering on metals at 40 to 80 kev, angular and energy distribution from, 18: 20783
sputtering on metals at 20 to 1000 ev, mass dependence of, 18: 20786
ARGON ISOTOPES Ar-36
content in meteorites, 18: 20726
energy levels from sulfur-32 (α,γ) and chlorine-35 (p,γ) reactions, 18: 21264
ARGON ISOTOPES Ar-37
content in meteorites, 18: 20815 (BNL-7948)

ARGON ISOTOPES Ar-38
content in meteorites, 18: 20726
energy levels from sulfur-34 (α,γ) reactions, 18: 21264
ARGON ISOTOPES Ar-39
content in meteorites, 18: 20815 (BNL-7948)
ARGON ISOTOPES Ar-40
content in meteorites, 18: 20726
ARGON ISOTOPES Ar-41
beta decay of, circular polarization of gamma radiation following, 18: 21309
ARGON SYSTEMS
air–Ar, electric breakdown in plane-point and plane-wire gaps, 18: 20148
Ar–Hg, electric discharge in, resonance radiation from, 18: 21464
Ar–H_2O, performance in ionization chambers, 18: 20393
Ar–Ne, radioinduced ionization in thermionic cells, fission-fragment, 18: 20860
Ar–O, radiolysis of, ozone formation in, 18: 20095
ARGONNE ADVANCED RESEARCH REACTOR
development, 18: 21698(R) (ANL-6860)
ARGONNE FAST REACTOR EXPERIMENT TEST
design and development, 18: 21698(R) (ANL-6860)
ARMY REACTORS (ML-1)
personnel for, training program for, 18: 21655
ARMY REACTORS (SM-1)
core-III production, 18: 21629 (ACNP-63638)
ARSENIC
determination in oxidized iron surfaces, activation, 18: 19903
effects on superconductivity of niobium–tin alloys, 18: 21110
separation of antimony from, by pyrogallol precipitation, 18: 19855(T) (UCRL-Trans-1011(L))
ARSENIC FLUORIDES
complexes with xenon hexafluorides, properties of, 18: 19999
ARSENIC ISOTOPES As-74
use in brain scanning, 18: 19817
ARSENIC ISOTOPES As-77
energy levels, 18: 21351
gamma decay of, directional correlation and polarization-direction correlation in, 18: 21351
ARSENIC OXIDES
As_2O_5–Nb_2O_5, crystal structure of tetragonal phases in, 18: 19942
As_2O_5–Ta_2O_5, crystal structure of tetragonal phases in, 18: 19942
ARTERENOL
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
ASCORBIC ACID
protective effects in Serratia against x radiation, 18: 19785
ASPARAGINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
ASTATINE ISOTOPES At-212
alpha decay, 18: 21709(R) (MLM-1179)
ASTROPHYSICS
book: *Cosmic Dust*, 18: 20720(T)
calculation of stellar pulsation, 18: 20716
combined helium and hydrogen burning in red giants, 18: 20727
fib theory and its influence on astronomical observation methods, 18: 20719
gravitational collapse of massive stars, radiation from, 18: 20715
interstellar gas and galactic halo, 18: 20724
large-scale magnetic field in exploding galaxy M82, 18: 20718
polarization of starlight in the interstellar medium, 18: 20725
spectra of main-sequence B stars, comparison of calculated and observed continuous, 18: 20714
x-ray emission by neutron stars, 18: 20711
ATLANTIC OCEAN
cesium content in, comparison of Indian and Pacific Oceans with, 18: 20220
ATMOSPHERE
content of bromine, chlorine, and iodine in, 18: 19837(R) (MIT-905-1)
electrical state of upper, 18: 21078
electromagnetic wave emission in, v-l-f, 18: 21088
gamma spectrum in upper, equipment for measuring, 18: 20411
particle diffusion in nonuniform, 18: 20620
radioactivity in, from power plants using fossil fuels, 18: 20265
ATOMIC BEAMS
stabilization of, equipment for, 18: 20757
ATOMIC ENERGY
nuclear installations act for British, 18: 20247
ATOMIC EXPLOSION
aurora from, spectrogram of artificial, 18: 21073
contamination of municipal water facilities by nuclear attacks, 18: 20233 (NP-13806)
effects of Hardhat event on electrical potential of ground, 18: 20200 (ARA-1054)
effects on tumor incidence in residents of Hiroshima and Nagasaki, 18: 19596
fallout from, distribution in atmosphere, 18: 21082
geophysical effects, 18: 21085
isotope production and recovery from, in salt, 18: 20121 (CONF-470-1)
myelofibrosis-induction in Hiroshima by, 18: 19568
production of heavy isotopes by, 18: 20126 (UCRL-7770)
radioactivities produced by, 18: 20124 (UCRL-7761)
radioinduced carcinogenesis from, in Hiroshima and Nagasaki, 18: 19580
radioinduced carcinogenesis and leukemia from, in Hiroshima and Nagasaki, 18: 19581
seismic data from Coast and Geodetic Survey in nuclear detonation series, 1961 to 1963, 18: 20201 (NP-13867)
seismic effects on structures, 18: 20127 (UCRL-7773)
shock waves in granite from Hardhat event, calculation, 18: 20125 (UCRL-7762)
waves from U.S.S.R. 1962, atmospheric, 18: 21072
ATOMIC PHYSICS
calculation of electron-produced electrostatic potential at nuclei of atoms, 18: 20744(T)
cluster expansion in the Heitler-London approach to many-electron problems, 18: 20747
dipole-quadrupole and retardation effects in low-energy atom-atom scattering, 18: 20733 (WIS-TCI-41)
energy minimum principle for Hartree-Fock calculations of excited atomic states, 18: 20808
energy transfer in atom-molecule collisions, 18: 20776
modification of available momentum region in Thomas-Fermi theory, 18: 20778
resonance behavior of scattering cross sections for atomic collisions, 18: 20765
theory of core-electron contributions to hyperfine interactions, 18: 20749
Thomas-Fermi theory of the atom, 18: 20748
ATOMIC STRUCTURE
electron shell order in ionized atoms, 18: 20758
ATOMS
cluster expansion in the Heitler-London approach to many-electron problems, 18: 20747
electron energy levels of, wave equations for excited, 18: 20808
electron shell order in ionized, 18: 20758
hyperfine structure of, core-electron contribution to, 18: 20749
interactions with atoms, dipole-quadrupole and retardation effects on cross sections for elastic, 18: 20733 (WIS-TCI-41)
ion reactions with, resonance charge exchange in, 18: 20769
ionization by slow negative ions, 18: 20772
model of many-electron, statistics of interdependent electrons in screening-constant, 18: 20731 (RM-3803-AEC)
nuclear magnetic shielding by, 18: 21232
nuclear magnetic shielding constants for 2-, 3-, and 4-electron, 18: 21233
photoionization, 18: 20770
potential at nuclei of, calculation of electrostatic electron-produced, 18: 20744(T)
reactions with diatomic molecules, vibrational energy transfer in, 18: 20776
scattering by atoms, resonance behavior of cross sections for, 18: 20765
theory for, Thomas-Fermi, 18: 20748
x-ray scattering by, parameters for, 18: 20809
ATROPINE

effects of, on radiation effects on oxygen consumption by rats, 18: 19742
AUDITORY ORGANS
radiation effects on rat, gamma and x, 18: 19562
AUGER ELECTRONS
yields from ion reactions with crystal surfaces at 4 to 100 ev, 18: 20780
AURORAL STORMS
charged-particle distributions in, solid-state detectors for, 18: 20364
production by earth's radiation belts, 18: 21087
spectrogram of artificial, 18: 21073
AUTOPSIES
findings at, on residents of Hiroshima and Nagasaki, 18: 19596
AUTORADIOGRAPHY
of plant materials, methods for, 18: 19856
of tritium-labeled *Vicia faba* chromosomes, 18: 19518 (BNL-7007)
use in industry, 18: 20425
AZO DYES
analytical use of di- and mono-, for niobium, 18: 19913
complexes of arsenazo with rare earths and scandium, composition of, 18: 19948

B

BACTERIA
bactericidal effects of irradiated ammonium chloride–glucose medium on *Pseudomonas sp.*, 18: 19627
effects of irradiated nitrogen gas on irradiation in Azotobacter, review of, 18: 19721
effects on mouse skin homograft survival, 18: 19511
inactivation by tritium-labeled thymidine, 18: 19633
protective effects of radiation-resistant, against radiation effects on mice, 18: 19808
radiation effects on species composition of, in canned fish, meat, and peas, 18: 19558(T) (JPRS-24187)
radiation effects on Streptomyces antibiotic activity against, background, 18: 19560
radiation effects on *Coliform bacterium*, 18: 19688
radiation effects on *pseudomonas sp.*, 18: 19627
radiation effects on growth-phases of *Pseudomonas sp.*, 18: 19628
radiation effects on catalase activity in strains of *Mycobacterium tuberculosis*, x, 18: 19607
radiation effects on pork, gamma, 18: 19617
radiation effects on rabbit antibody production for, x, 18: 19738
radiation effects on *Serratia marcescens*, protective effects of chemicals against, x, 18: 19785
radioinduced mutations in *Bacillus subtilis*, ultraviolet, 18: 19753
radiosensitivity of *Micrococcus radiodurans*, effects of age, iodoacetic acid, and organic compounds on, 18: 19751
surface binding of calcium and magnesium by *Pseudomonas piscicida* in sea water, 18: 19520(R) (TID-20499)
BACTERIOPHAGES
inactivation by tritium-labeled thymidine, 18: 19633
radiation effects on T1, effects of freeze-drying, low temperature, and sulfhydril compounds on, 18: 19634
radioinduced in *E. coli*, 18: 19739
BALANCES
design for use in hot cells, 18: 20134(R) (ORNL-TM-792)
BARIUM
content in stellar red giants, mechanisms for, 18: 20727
determination in lubricants, computer routine for activation, 18: 19918
use in radiation protection pastes for skin in radiotherapy, 18: 19832
BARIUM ISOTOPES Ba-137
determination by liquid scintillation coincidence circuit, 18: 19891
BARIUM ISOTOPES Ba-140
purification, 18: 21708(R) (MLM-1178)
purification of stock solutions of, 18: 21709(R) (MLM-1179)
BARIUM NIOBATES
luminescence of, self-activated, 18: 20060
BARIUM NITRATES
radiation effects on, 18: 20080
BARIUM OXIDES
performance as emitter in low-voltage arcs, 18: 20851
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))
$BaO–UO_3$–W, development as thermionic emitters, 18: 20877
BARIUM SULFATES
effects on blood coagulation, 18: 19535
BARIUM SULFIDES
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))
BARIUM TANTALATES
luminescence of, self-activated, 18: 20060
BARRIERS
fabrication of porous, for isotopic separation of gases, 18: 20437(P)
BARYONS
classification in SU(4), 18: 20931
field theory for, charge conservation in, 18: 21024
field theory of, eightfold-way symmetry in, 18: 21045
interactions with baryons, resonances in, 18: 20911 (NP-13873)
mass splittings of baryon-meson from symmetry-breaking tadpole diagrams, 18: 20941
mass vector for pseudoscalar octet in unitary symmetry, 18: 20939
Regge poles and resonances, 18: 20996
Regge poles in perturbation theory of, 18: 20997
resonance models and symmetries of, octet and Sakata, 18: 20994
resonance singularities in systems of, 18: 20911 (NP-13873)
resonances, spin-parity of, 18: 20998
symmetries of, R invariance in group, 18: 20995
BEARINGS
development of plain and roller, for use in dry helium atmosphere in reactor, 18: 21575
performance of gas-lubricated, 18: 21095(R) (NBS-8239)
BEHAVIOR
of mammals, effects of manganese on, 18: 21700 (BNL-7855)
radiation effects on rat saccharin, x, 18: 19667
radiation effects on monkey and rat, x, 18: 19586
radiation effects on, in antenatally irradiated dogs, 18: 19608(T)
BELGIAN REACTOR-2
fuel element testing in, 18: 20459(T,R) (EURAEC-954)
radiation field measurements in, development of calorimeter sondes for, 18: 20379
BELGIAN REACTOR-3
burnup calculations for, 18: 21654
fuel element development for, 18: 20459(T,R) (EURAEC-954)
fuel element development and fabrication for, 18: 20460(T,R) (EURAEC-965)
BENZALDEHYDE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BENZENE
compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
deuteron quadrupole relaxation in liquid perdeutero-, measurement of, 18: 19962
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
electron impact excitation cross section of vibrational states in, effects of vibronic interactions on, 18: 20760
radiolysis of aqueous solutions of, effects of hydrogen peroxide and nitrous oxide on hydroxyl radical yields in, 18: 20047
radiolysis of, yield of free radicals in, 18: 20042 (USNRDL-TR-718)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
x-ray scattering cross sections, 18: 20035
benzene–toluene, radiation effects on normal and deuterated, 18: 20054
benzene-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
BENZENE, IODO-
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BENZENE, NITRO-
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BENZENES, ALKYL-
radioinduced degradation in HNO_3–TBP solution, 18: 20100 (ORNL-3524)
BENZENETHIOL
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BENZONITRILE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BENZOYL HALIDES

methanolysis of, mass spectrographic analysis of oxygen isotope effect in methanol solution at 25°C, 18: 19837(R) (MIT-905-1)
BENZYL ALCOHOL
analysis for oxygen-18, mass spectrographic, 18: 19837(R) (MIT-905-1)
BERYLLIUM
analysis of high-purity, activation, 18: 19876
analysis of, gamma activation, 18: 21709(R) (MLM-1179)
bremsstrahlung reactions at 44 and 56.5 Mev, production of beryllium-7 in, 18: 21328
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination of, complexometric, 18: 19908
fabrication and uses of ingot sheet, 18: 20496
joining to stainless steel, development of brazing method for, 18: 20134(R) (ORNL-TM-792)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
nuclear magnetic shielding constants for, 18: 21233
production by electrolysis, 18: 20466(P)
radiation effects on, at 450 to 650°C, fast neutron, 18: 20579 (AAEC/E-115)
reactions in oxidizing environments, 18: 19985
sputtering by rare gas ions at 20 to 1000 ev, mass dependence of, 18: 20786
BERYLLIUM ALLOYS
Be–Cu, phase transitions in, oscillation damping in, 18: 20560
BERYLLIUM CHLORIDES
entropy at 1573 to 1723°K, 18: 19969
heat of formation at 1573 to 1723°K, 18: 19969
$AlCl_3$–$BeCl_2$, phase diagram, 18: 19950
BERYLLIUM FLUORIDES
BeF_2–LiF, chronopotentiometry and voltammetry of iron in liquid, 18: 19966
BeF_2–LiF–UF_4–ZrF_4, analysis for chromium by amperiometric titration, 18: 19869
BERYLLIUM IONS
nuclear magnetic shielding constants for, 18: 21233
wave functions for $1s^22s$ configuration of, self-consistent, 18: 20759
BERYLLIUM ISOTOPES Be-7
content in stratosphere, production mechanisms for, 18: 21080
nuclear deformation parameters and energy levels for, 18: 21307
production in bremsstrahlung reactions at 44 and 56.5 Mev with beryllium, boron, and graphite, 18: 21328
BERYLLIUM ISOTOPES Be-8
nuclear deformation parameters and energy levels for, 18: 21307
BERYLLIUM ISOTOPES Be-9
deuteron reactions (d,α) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
nuclear deformation parameters and energy levels for, 18: 21307
nuclear models for, simple, 18: 21349
proton scattering at 5 to 15 Mev, differential cross sections for, 18: 21362
spectra in beryllium oxide single crystals, NMR, 18: 20017
BERYLLIUM ISOTOPES Be-10
determination in iron meteorites, 18: 20221
nuclear deformation parameters and energy levels for, 18: 21307
BERYLLIUM OXIDES
beryllium-9 NMR spectra in single crystals of, 18: 20017
corrosion by cesium at 750°C, 18: 20873
deposition of coatings of, on fuel particles, 18: 20450(R) (BMI-1661 (Del.))
deposition on thorium(IV) oxide and uranium(IV) oxide particles, 18: 20570
diffusion of xenon-133 in, 18: 20570
electric conductivity, 18: 20576
fabrication by extrusion and sintering, 18: 20499
fabrication of, use of ceramic processing methods for, 18: 20462
fission gas release from coatings of, 18: 20450(R) (BMI-1661(Del.))
grain growth and sintering of, kinetics of, 18: 20500
grinding of, development of equipment for, 18: 20134(R) (ORNL-TM-792)
point defects in, compressibility, energy of formation, and lattice energy of fully ionized, 18: 20576
preferred orientation in extruded and sintered tubes of polycrystalline, 18: 20532 (UCRL-7381-T)
preparation and properties of sintered pellets of, 18: 20503
preparation and properties of single crystals of, 18: 20015
pressing and sintering of, cold, 18: 20502
processing of reactor fuels containing, economics and methods of, 18: 20116
properties as capacitance temperature sensors, 18: 21564(R)
properties in high-temperature gas-cooled reactors, 18: 21660
properties of ceramics containing, 18: 20462
radiation effects on, electron, 18: 20604
radiation effects on, neutron, 18: 20605
radiation effects on x-ray scattering by, 18: 20607
radiation effects on x-ray line broadening in, 18: 20608
radiation effects on density, lattice parameters, and size of, annealing effects on fast-neutron, 18: 20609
radiation effects on, at 75 and 500 to 700°C, fast-neutron, 18: 20610
radiation effects on thermal conductivity of, at 2 to 300°K, fast-neutron, 18: 20611
radiation effects on, tritium release following, 18: 20612
radiation effects on, tritium release following, 18: 20613
radiation effects on ESR spectra of, gamma, 18: 20614
radioinduced lattice growth of, effects on strength, 18: 20606
reactions with water vapor at 1065 to 1380°C, 18: 20016
sintering of, effects of powder properties on, 18: 20501
sintering of, optimum conditions for, 18: 20505
sorptive properties for carbon dioxide and water, 18: 20014
stress-rupture testing, 18: 20573
structure and thermal vibrations at 900°C, 18: 20574
structure of, combined neutron and x-ray diffraction technique for studying, 18: 20575
thermal shock resistance at 25 to 630°C in liquid metals, molten salts, and water, 18: 20571
Be–BeO–UO_2, fabrication and properties of sintered pellets of, 18: 20504
BeO–MgO, phase studies, 18: 20577
BeO–PuO_2–ThO_2, development for pebble-bed reactors, 18: 21658
BeO–ThO_2–UO_2, diffusion of xenon-133 in, 18: 20572
BeO–ThO_2–UO_2, fabrication of dispersions of, for optimum crystal structure, 18: 20498
BeO–ThO_2–UO_2, fabrication of dispersions of, by cosintering, 18: 20483 (AAEC/E-116)
BeO–ThO_2–UO_2, radiation damage due to fission products in, 18: 20615
BeO–UO_2, fabrication by cold extrusion, 18: 20497
BeO–UO_2, fabrication into pellets for irradiation, 18: 20450(R) (BMI-1661(Del.))
BeO–UO_2, performance in gas-cooled reactors, 18: 21659
BeO–UO_2, properties as rocket reactor fuel, testing of, 18: 21698(R) (ANL-6860)
BERYLLIUM SYSTEMS
Be–BeO–UO_2, fabrication and properties of sintered pellets of, 18: 20504
BETA DECAY
asymmetry of, in nuclei polarized by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
energy requirements and forbidden character of positron emission in, 18: 21227
gamma circular polarization following, 18: 21309
radiative corrections to, mediated by a vector boson, 18: 21010
theory of, bibliography on, 18: 21353
theory of, conserved vector current and universal Fermi interaction for, 18: 21306
theory of, Fierz interference in electron capture-positron emission ratio in, 18: 21245
theory of, lectures on, 18: 21187 (KR-64(Sect.IV))
theory of, strong interaction effects in Feinberg-Pais, 18: 20950
theory of, test of conserved vector-current, 18: 21269
BETA PARTICLES
application to dog lymph system, method for selective, 18: 19601
attenuation by diamonds, 18: 20746
biological effects on cornea tissue, tracer studies of, 18: 19708
detection and measurement of tritium-emitted, development of scintillation counter for, 18: 19887

detection and measurement of low-energy environmental, instrumentation for, 18: 20341 (TID-20564)
detection and measurement of, design of 4π scintillation detector for, 18: 20380
detection and measurement of, in air and precipitation at French reactor sites, 1961 and 1962, 18: 20209 (CEA-2397)
effects on blood cells in chronic leukemia, 18: 19789
effects on frog cardiac activity, 18: 19564
effects on hamster fibroblast mortality, 18: 19645
effects on HeLa cells, 18: 19644
effects on human chromosomes, 18: 19583
effects on human kidney cells, methods for modification of, 18: 19760
effects on succinic dehydrogenase and succinic thiokinase activity in Rhodotorula, protective effects of cystamine against, 18: 19786
excitation of organic solutions by phosphorus-32, 18: 20046
induction of jute aberrant growth by, 18: 19725
therapy for polycythemia, effects on blood volume, 18: 19661
use for determination of radioisotopes in two-component mixtures, 18: 19911

BETA SOURCES
analysis of mixed, by liquid scintillation counting, 18: 19872
analysis of mixed, counting conditions for, 18: 19873
detection of, efficiency of scintillation, 18: 20352
preparation of uranium, electrolytic, 18: 20422

BETA SPECTROMETERS
design of double-focusing, 18: 20405
design of 4π scintillation, 18: 20360
design of, using post-accelerating G-M tube, 18: 20361
performance of, using silicon surface barrier detectors, 18: 20355

BETA SPECTROSCOPY
instruments and methods for, review, 18: 20332 (KR-64(Sect.XII))

BETATRONS
electron injection processes in, 18: 20689

BIBENZYL
production by pyrolysis of ethyl iodide in toluene, 18: 20023 (TID-20510)

BIBLIOGRAPHIES
of ORNL publications, reports, and papers, 1963, 18: 21714 (ORNL-3300(Vol.3))
on asymptotic relations between scattering amplitudes, 18: 20907 (JINR-P-1564)
on chemical detectors, 18: 19847 (LAMS-2378(Vol.II))
on circular polarization of gamma quanta emitted by nuclei after beta decay, 18: 21309
on corrosion-resistant niobium alloys, 18: 20475 (VDDIT-87)
on determination of cesium, lithium, and rubidium, 18: 19853(T) (CEA-tr-R-1711)
on developments in support of laboratory programs, 18: 21715(R) (ORNL-TM-791)
on differential thermal analysis, 18: 19864
on diffusion in metals and alloys, 18: 20536(T) (AEC-tr-6313)
on emission spectrometry, 18: 19863
on fluorometric analysis, 18: 19858
on gravimetric and volumetric analytical methods for inorganic compounds, 18: 19865
on ion exchange chromatography, 18: 19857
on ion exchange separations, 18: 19859
on isotope geology, 18: 20207
on kinetic aspects of analytical chemistry, 18: 19868
on light absorption spectrometry, 18: 19860
on liquid metals, alloys, and their applications, 18: 20444 (AD-417111)
on mass spectrometry, 18: 19861
on mechanical properties of thin films, 18: 20515 (CONF-356-11)
on mechanical properties of refractory metals and their alloys, 18: 20456 (ORNL-3593)
on Mössbauer effect in chemistry and solid state physics, 18: 19998
on nuclear techniques in agriculture, 18: 20423
on nuclear theory, 18: 21353
on nucleonics, 18: 19867
on physical properties of liquid metals, 18: 20516 (EUR-599.d)
on preparation and properties of organic ion exchangers containing arsenic or phosphorus, 18: 19838 (UJV-909/63)
on properties of coated refractory metals, 18: 20452 (DMIC-195)
on radiation effects on mechanical properties of refractory metals, 18: 20456 (ORNL-3593)
on radiation effects on properties of polymers, 18: 20089
on radiation stability of plastics and rubbers, 18: 20582 (NIRL/R/58)
on radiation yields and reactions in dilute inorganic solutions, 18: 20037 (BNL-6978)
on radiobiological dosimetry, 18: 19549 (NP-13857)
on reports on developments in engineering, fabrication, and field support of laboratory programs, 18: 21716(R) (ORNL-TM-794)
on solvent extraction in radiochemistry, 18: 20085
on solvent extraction processes, 18: 20103
on stability of fluid configurations and flows, 18: 20621 (AFCRL-62-1075)
on very high-pressure shock waves in metals, 18: 20454 (LADC-5561)
on x-ray absorption and emission, 18: 19862
on x-ray diffraction analysis, 18: 19866
radiation effects on high-melting materials and metals, 18: 20601

BILIRUBIN
radiation effects on conjugation and excretion of, in rat liver, 18: 19632

BINDING ENERGY
of electrons, photoelectron method of determining, 18: 20766
of hypertritium for nonlocal interaction, 18: 21182 (JINR-P-1579)

BIOCHEMISTRY
radiation effects on dog, whole-body, 18: 19603

BIOLOGICAL MATERIALS
analysis for calcium/strontium ratios, x-ray-fluorescence, 18: 19849 (PG-Report-583)
analysis for trace amounts of sodium, radiochemical, 18: 19841 (CONF-187-112)
irradiation of wet, ESR spectrometer for, 18: 20293
radiation dosimetry in, 18: 19549 (NP-13857)
radiation quality and its effect on, 18: 19570

BIOLOGICAL SYSTEMS
dynamics of metabolic processes in open, 18: 19537

BIOMETRY
formulas for determination of tracer dynamic parameters for turnover of metabolites in biological systems, 18: 19537
models for strontium metabolism in man, 18: 20235 (NP-13868)

BIOSYNTHESIS
cell-free virus, 18: 21725(R) (TID-20437)

BIPHENYL
alpha and electron excitation of, pulse-height ratios for, 18: 20408
radiolysis of, yield of free radicals in, 18: 20042 (USNRDL-TR-718)
biphenyl–phenyl ether, neutron age in, 18: 21138

BIRDS
radioactivity of sparrow, effects of environment on, 18: 19517

BISMUTH
effects on superconductivity of niobium–tin alloys, 18: 21110
effects on thallium superconducting transition temperature, 18: 21113
fabrication of targets of, for polonium-208 production in Mark I accelerator, 18: 20486 (MTA-15)
neutron scattering at 15.2 Mev, angular distributions in elastic, 18: 21340
performance as reactor coolant, evaluation of, 18: 20192
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
use in radiation protection pastes for skin in radiotherapy, 18: 19832

BISMUTH ALLOYS
$BiLi_x$, formation in liquid lithium chloride–lithium fluoride eutectic, 18: 19978
Bi–Pb, physical properties of liquid eutectic, review, 18: 20516 (EUR-599.d)
Bi–Pb, superconductivity of, surface, 18: 21101
Bi–Th, separation of uranium from solid intermetallic compounds of, 18: 20118(P)
Sb–Cs, performance as collector for thermionic cells, 18: 20870

BISMUTH ISOTOPES Bi-199
alpha-active isomers of, energy levels and half lives of, 18: 21258

BISMUTH ISOTOPES Bi-201
alpha-active isomers of, energy levels and half lives of, 18: 21258

BISMUTH ISOTOPES Bi-206
uptake and distribution in rats, 18: 19529
uptake by dogs, effects on skin homografts, 18: 19605

BISMUTH ISOTOPES Bi-210
beta decay of, polarization of electrons in, 18: 21324
BISMUTH ISOTOPES Bi-212
conversion electron spectra, 18: 21313
BISMUTH SYSTEMS
Bi–LiCl–KCl, chemical state and distribution coefficient of copper in, 18: 19983
BLADDER
radiotherapy of carcinoma of urinary, 18: 19827
BLAST EFFECTS
on man, therapy of, 18: 19793
BLOOD
extracorporeal irradiation of, use in studies of lymphocyte proliferation and function, 18: 19548 (BNL-7926)
radiation effects on corticosterone content of rat, x, 18: 19676
radiation effects on morphology of peripheral, 18: 19677
radiation effects on enzymes in dog, 18: 19683
radiation effects on human, homogeneous vs. inhomogeneous, 18: 19584
radiation effects on dog, whole-body, 18: 19603
radiation effects on erythropoiesis in rabbit, gamma, 18: 19611(T)
radiation effects on leukocyte distribution in rabbit, gamma, 18: 19697
radiation effects on phosphonucleoside content of rat, 18: 19702
radiation effects on loss of, in dogs and rabbits, 18: 19732
radiation effects on, telecobalt gamma, 18: 19749
radiotoxins released by, 18: 19653
BLOOD CELLS
radiation effects on DNA, RNA, fat, glycogen, and peroxidase metabolism in, x, 18: 19730
radiation effects on chronic leukemia, beta, 18: 19789
BLOOD COAGULATION
effects of actinides and lanthanides on, 18: 19535
effects of actinides and lanthanides on, 18: 19536
BLOOD DISEASES
yttrium-90-induced hemorrhagic diathesis in dogs, 18: 19600
BLOOD FORMATION
kinetics and regulation of, 18: 19504
BLOOD PICTURE
effects of hookworm infection on, 18: 21724(R) (TID-20404)
radiation effects on, in animals irradiated at 3270 to 5400 r, 18: 19703
radiation effects on, from combined external and internal irradiation of rats, 18: 19705
radiation effects on, of goldfish, 18: 19756
BLOOD PLASMA
calcium-45, phosphorus-32, and strontium-89 content in cow and goat, method for establishing constant, 18: 19541
effects of anemic, on effects of bone marrow transplantation in treatment of radiation sickness, 18: 19804
BLOOD PLATELETS
proliferation kinetics and regulation, 18: 19504 (BNL-7839)
protective effects against human radiation injury, 18: 19763
BLOOD PRESSURE
role of salt ingestion and genetic factors in hypertension in man and rats, 18: 21702 (BNL-7971)
BLOOD SERUM
factor sensitive to actinides and lanthanides, 18: 19535
factor sensitive to actinides and lanthanides, method for assay of, 18: 19536
preparation of labeled colloidal aggregates of albumins from, for use in pathema localization by photoscanning, 18: 19813 (CONF-164-11)
radiation effects on proteins in rat, temperature effects on, gamma, 18: 19642
radiation effects on protein metabolism in mouse and rat, x, 18: 19590
radiation effects on protein fractions in, in animals irradiated at 3270 to 5400 r, 18: 19703
radiation effects on extracellular space in, 18: 19718
radiation effects on proteins of rat, x, 18: 19754
BLOOD VESSELS
radiation effects on mouse hind limb, x, 18: 19640
BLOOD VOLUME
radiation effects on, after polycythemia therapy, beta, 18: 19661
BLOWERS
design for 630A Maritime Nuclear Steam Generator, 18: 21668(R) (GEMP-274)
BOILERS
design for organic-saturated pool boiling study, 18: 21554 (NAA-SR-Memo-8061)
testing of mercury, 18: 21675 (NP-13795)
BOILING
bubble formation in nucleate, surface temperature fluctuations during, 18: 20162 (EUR-1622.f)
burnout heat flux in rod bundle, effects of rod spacing on, 18: 20161 (AEEW-R-178)
burnout measurements in, design of test loop for, 18: 20180 (TID-7694(p.87-8))
film, in forced convection inside tubes, 18: 20174 (TID-7694(p.37-41))
film, stability in two-phase flow in cryogenic systems, 18: 21119
flow patterns in, in vertical pipes, 18: 20176 (TID-7694(p.44-51))
heat transfer burnout in liquid metal systems, 18: 20160(R) (AD-423679)
heat transfer burnout in liquid metal systems, 18: 20166(R) (NP-13810)
heat transfer by, in ethylene glycol, freon, liquid metals, slurries, and water, 18: 20171 (TID-7694(p.18-23))
heat transfer in transition, 18: 20172 (TID-7694(p.24-34))
hydrodynamic stability and heat transfer in, 18: 21698(R) (ANL-6860)
of liquid metals, effects of electrostatic fields and surface character on, 18: 20174 (TID-7694(p.37-41))
pressure drop and stability in, in 8-atm loop, 18: 20178 (TID-7694 (p.61-70))
pressure losses in convection, 18: 20175 (TID-7694(p.42-3))
pressure pulses in rapid transient, thermal mechanism of, 18: 21549 (CONF-187-111)
stability of, thermal, 18: 20187
transient behavior of two-phase forced-circulation, in channels permitting cross-flow, 18: 20165 (NAA-SR-Memo-8123)
vapor volume fraction in, 18: 20170 (TID-7694(p.11-17))
BOILING REACTOR EXPERIMENTS
operation of peripheral superheater core in BORAX-V, 18: 21698(R) (ANL-6860)
pressure pulses in BORAX-I destructive transient, thermal mechanism of, 18: 21549 (CONF-187-111)
BOILING REACTORS
channel hydrodynamic stability in, effects of flow control device on, 18: 21573 (NYO-10475)
coolant radiolytic decomposition in, hermetic sealing problems in, 18: 21672 (NAA-SR-Memo-9507)
core two-dimensional two-phase flow model and IBM 7090 code for, 18: 21557 (NAA-SR-Memo-9444)
economic and safety aspects of containers for, 18: 21647
fluid flow in, control device for two-phase, 18: 20173 (TID-7694(p.35-6))
fuel elements for, development of vapotron claddings for, 18: 21617 (TID-7694(p.71-84))
heat transfer and stability in, 18: 20177 (TID-7694(p.53-60))
heat transfer by vortex flow in, 18: 20181 (TID-7694(p.89-107))
heat transfer in two-phase flow in, 18: 20169 (TID-7694(p.7-10))
heat transfer in two-phase flow in, 18: 20170 (TID-7694(p.11-17))
stability against oscillations, 18: 20178 (TID-7694(p.61-70))
stability in design of, thermal, 18: 20187
steam exit quality control in channels in, development of device for, 18: 21573 (NYO-10475)
BONE FRACTURES
radioinduced in femur after radiotherapy of adenocarcinoma of uterus, 18: 19713
radioinduced, after supervoltage radiotherapy, 18: 19693
BONE MARROW
cell proliferation in, 18: 19509
cell separation in, technique for, 18: 19525
cell type determination in rat, 18: 19510
effects of irradiated, on radioinduced rat liver degeneration, 18: 19790
oxygen balance in rabbit, effects of injected radiation protection chemicals on, 18: 19801
poststorage viability of human, 18: 19526
protective effects following chemotherapy for malignant diseases, 18: 19768
protective effects against human radiation injury, 18: 19763

protective effects against whole-body irradiation in dog and man, 18: 19764
protective effects of transfusions of, in irradiated animals, 18: 19769
protective effects against x radiation in mice, 18: 19770
protective effects of fresh vs. stored, in irradiated mice, 18: 19777
protective effects against x irradiation in mice, 18: 19796
protective effects against active radiation sickness, 18: 19804
protective effects of frozen and stored, in x-irradiated mice, 18: 19805
radiation effects on lipid metabolism in human, 18: 19552(R) (NYO-2769-1)
radiation effects on stem cell kinetics in fasted mouse, 18: 19636
radiation effects on repopulation in man and mouse, x, 18: 19592
radiation effects on cytology of human, gamma and neutron, 18: 19602
radiation effects on mouse, protective effects of homologous cells against, 18: 19767
radioinduced fibrosis of, in Hiroshima, 18: 19568
radiosensitivity of cells of, in rats, 18: 19660

BONES
alpha-emitter content of human, 18: 19532
radiation effects on growth of rat, x, 18: 19555 (USNRDL-TR-721)
radiation effects on morphogenesis of embryonic chick tibiotarsus, 18: 19657
radiation injuries to, after telecobalt and x-ray therapy, 18: 19673
radium deposition in, of goldfish, 18: 19756

BORATE IONS
tetra-*p*-methoxyphenyl- and tetraphenyl-, solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)

BORIC ACID
properties as reactor chemical shim, 18: 21652
sorption from solution by alumina, 18: 21565 (IDO-16812)

BOROHYDRIDE IONS
reactions with ferricyanide ions in aqueous solutions, kinetics of, 18: 19938 (UCRL-11252)

BORON
bremsstrahlung reactions at 44 and 56.5 Mev, production of beryllium-7 in, 18: 21328
determination in zirconium diboride, 18: 19882
diffusion in refractory metals, conditions for, 18: 20540
production by reduction of chloride or fluoride in plasma, 18: 19932 (KY-453)
reactor criticality effects of, pulsed-neutron determination of, 18: 21595 (CEA-R-2376)

BORON CARBIDES
neutron sensitivity of, effects of carbon dioxide on thermal, 18: 20348

BORON CHLORIDES
reduction to boron in plasma, 18: 19932 (KY-453)

BORON FLUORIDE COMPLEXES
with xenon hexafluorides, properties of, 18: 19999

BORON FLUORIDES
reduction to boron in plasma, 18: 19932 (KY-453)

BORON HYDRIDES
spectra of liquid, solid, and vaporous deca-, infrared absorption, 18: 19937 (TID-20514)

BORON IONS
nuclear magnetic shielding constants for, 18: 21233
wave functions for $1s^2 2s2p$ configuration of, self-consistent, 18: 20759

BORON ISOTOPES B-8
beta decay of, beta-alpha angular correlations in, 18: 21306

BORON ISOTOPES B-9
nuclear deformation parameters and energy levels for, 18: 21307

BORON ISOTOPES B-10
helium-3 reactions (He-3,$p\gamma$) at 15.1 Mev, excitation and resonances in, 18: 21336
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron reactions (n,α) with gases of, pressure wave generation in, 18: 21268
nuclear deformation parameters and energy levels for, 18: 21307
performance as poison for ANP open-cycle reactor, 18: 21561 (APEX-603(Del.))

BORON ISOTOPES B-11
deuteron reactions (d,$n\gamma$) at 15.1 Mev, resonances in, 18: 21336
nuclear deformation parameters and energy levels for, 18: 21307

BORON ISOTOPES B-12
beta decay, 18: 21306
nuclear deformation parameters and energy levels for, 18: 21307

BORON NITRIDES
development and properties as diffusion barrier for refractory metals, 18: 20445(R) (AD-434441)
emissivity at 800 to 5000°K, relation of structure to, 18: 20566

BORON SYSTEMS
B–Cr–Ni, corrosion by cesium at 750°C, 18: 20873
B–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))

BOSONS
effects of charged vector, on lepton anomalous magnetic moment, 18: 20982
effects of vector, on meson (μ) and beta decay, 18: 21010
electromagnetic interactions of Yang-Mills field, 18: 21062
field operators for hard-sphere gas of, nonlocal, 18: 21028
interactions with fermions, Regge trajectories of backward-angle differential cross sections for, 18: 20942
interactions with baryons and bosons, 18: 20995
quantization of a self-coupled field, 18: 21002
relativistic field theory with scalar, 18: 21039
vacuum trajectory in conventional field theory, 18: 21063
vector, effect on muon decay of W, 18: 21306
vector, Regge poles in perturbation theory of, 18: 20997

BRAIN
krypton-85 and nitrous oxide uptake by anesthetized human, 18: 19522
oxygen balance in rabbit, effects of injected radiation protection chemicals on, 18: 19801
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)
photoscanning of, after injection of technetium-99m as pertechnetate, 18: 19814 (CONF-453-1)
radiation effects on extracellular space in, 18: 19718
radiation effects on rabbit, x, 18: 19728
radiodiagnosis of occlusive vascular disease in, using arsenic-74 and copper-64, 18: 19817
surgery on dog, effects of, with radiation on hemopoiesis, 18: 19733

BRASS
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
neutron attenuation by, from 14-Mev source, 18: 19821
plasma flow between electrodes of, velocity of, 18: 21485

BRAZING
methods development, 18: 20134(R) (ORNL-TM-792)

BREEDER REACTORS
fuel development for fast, 18: 21698(R) (ANL-6860)

BREMSSTRAHLUNG
emission by relativistic electrons at 32 Mev, angular distributions and polarization in, 18: 21013
production in electron reactions in lead, energy losses from, 18: 21334
production in relativistic electron reactions in media, 18: 20984
reactions (γ,n) with carbon-12, 18: 21328
reactions (γ,p) with carbon-12 and oxygen-16 up to 45 Mev, cross sections for, 18: 21163 (CONF-481-4)
reactions (γ,p) with silicon-28 at 15 to 30 Mev, energy distribution of protons from, 18: 21325
reactions with beryllium, boron, and graphite at 44 and 56.5 Mev, production of beryllium-7 in, 18: 21328

BROMINE
content in marine atmosphere, 18: 19837(R) (MIT-905-1)
effects on hydrogen yields in radiolysis of hydrobromic acid-hydrochloric acid and hydrochloric acid, 18: 20062
meson (π) Coulomb dissociation on, 18: 20891 (AD-433625)
oxidation of tritium-labeled aldoses by, isotope effects in, 18: 20031
proton reactions at 660 Mev, angular distribution of fragments from spallation, 18: 21229
proton spallation at 660 Mev, 18: 21230
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)

BROMINE ISOTOPES
neutron emission by, delayed, 18: 21221

BROMINE ISOTOPES Br-80

reactions of recoil, with hydrocarbons and halogenated hydrocarbons, 18: 20041 (MMPP-167-6)
BUBBLE CHAMBERS
design of propane, 18: 20389
development, 18: 21712(R) (NYO-10065)
particle track measurements in, error matrix for, 18: 20328 (BNL-7932)
particle track momentum and tangent measurements in, error calculations for, 18: 20329 (BNL-7933)
particle tracks in, microscopes for analyzing, 18: 20295
temperature regulator design for liquid-hydrogen, 18: 20367
use at CERN proton synchrotron, 18: 20400
use in elastic scattering experiments at high energy, 18: 20897 (CERN-64-6(p.31-48))
BUBBLES
formation in nucleate boiling, surface temperature fluctuations during, 18: 20162 (EUR-1622.f)
mass transfer mechanisms for gas, 18: 20189
BUILDING MATERIALS
analysis for moisture, neutron moderation method for, 18: 19905
gamma radioactivity of, 18: 20210 (CLOR-20)
BURNS
radioinduced chorioretinal, of rabbit eyes, 18: 19547(R) (AMRL-TDR-63-71)
treatment, 18: 19793
BUTANE
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
BUTANE, 1-BROMO-
radioinduced reactions with tin, 18: 20450(R) (BMI-1661(Del.))
BUTANE, 2-METHYL-
electric discharge in, secondary ionization in, 18: 20137
1-BUTANETHIOL
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BUTYL PHOSPHATES
solvent properties for manganese and protactinium, 18: 20105
spectra of uranium tetrachloride in tri-, absorption, 18: 19935 (TID-18814)
HNO_3–TBP–H_2O, calculation of cascade stagewise conditions for rare earth separation, 18: 20098 (IS-780)
kerosene–HNO_3–TBP, degradation and cleanup, 18: 20100 (ORNL-3524)
BUTYL SULFIDES
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
BUTYLAMINE
nuclear magnetic resonance of sorbed, on thorium oxide, temperature dependence of, 18: 20632 (TID-18689)
BUTYROPHENONES
photolysis and radiolysis of, use of mass spectra in, 18: 20063

C

CADARACHE REACTORS (RAPSODIE)
criticality studies of mockup of, 18: 21698(R) (ANL-6850)
CADMIUM
analysis for uranium by chemical stripping, 18: 19851(R) (TID-20548)
determination in nucleic acids, activation, 18: 19892
effects on thallium superconducting transition temperature, 18: 21113
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
CADMIUM COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946
CADMIUM ISOTOPES Cd-108
neutron reactions with, activation cross sections for thermal, 18: 21220
CADMIUM ISOTOPES Cd-109
electron capture ratios, 18: 20023 (TID-20510)
half life, 18: 21220
CADMIUM ISOTOPES Cd-110
energy levels, 18: 21355
CADMIUM ISOTOPES Cd-114
deuteron elastic scattering by, 18: 21161 (CONF-417-26)
CADMIUM ISOTOPES Cd-115
decay of, indium-115 energy levels from, 18: 21289
half life, 18: 21220
CADMIUM ISOTOPES Cd-116
neutron reactions (n,γ) with, isomeric cadmium-117 decay from, 18: 21288
CADMIUM ISOTOPES Cd-117
decay scheme of isomeric, 18: 21288
decay schemes and half life of isomers, 18: 19837(R) (MIT-905-1)
energy levels, 18: 21288
CADMIUM NIOBATES
luminescence of, self-activated, 18: 20060
CADMIUM SULFIDES
electric properties of radioactive films of, in vacuum and with adsorbed hydrogen, 18: 20674
use in gamma dose rate determinations, 18: 20351
CADMIUM TANTALATES
luminescence of, self-activated, 18: 20060
CADMIUM TELLURIDES
chromium-53 EPR in, parameters for, 18: 20019
CADMIUM URANATES
preparation and properties, 18: 20012
CALCITES
fission damage in, dating by, 18: 20224
CALCIUM
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in lubricants, computer routine for activation, 18: 19918
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination of ratio to strontium in powder samples, x-ray-fluorescence, 18: 19849 (PG-Report-583)
exchangeable, in soil samples from U.S., 18: 19515 (NP-13796)
metabolism of, in marine mollusks and bacteria, 18: 19520(R) (TID-20499)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
surface binding of, by marine bacteria, 18: 19520(R) (TID-20499)
turnover rate of, in man, 18: 20235 (NP-13868)
CALCIUM CARBIDES
use of carbon-14-labeled, for determination of water vapor in gases, 18: 19848 (ORO-591)
CALCIUM COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946
CALCIUM FLUORIDES
strontium incorporation in precipitates of, 18: 19949
CALCIUM HYDRIDES
reactions with zirconium oxides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
CALCIUM IODIDES
scintillation properties of crystalline, 18: 20375
CALCIUM ISOTOPES Ca-40
gamma reactions (γ,n) with, neutron energy spectra from, 18: 21257
nuclear ground-state properties of, calculation of, 18: 21346
nucleon binding energies, energy levels, and potentials for, 18: 21358
proton elastic scattering cross sections, 18: 21338
CALCIUM ISOTOPES Ca-45
content in blood plasma of cows and goats, method for establishing, 18: 19541
uptake by skeleton in miniature pigs, age effects on strontium-90 discrimination in, 18: 19539
CALCIUM NIOBATES
luminescence of, self-activated, 18: 20060
CALCIUM NITRATES
effects on separation of nitric acid from aqueous solutions by solvent extraction using long-chain amines, 18: 20107
CALCIUM OXIDES
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))
CaO–La_2O_3–ZrO_2, phase studies, 18: 20538

$CaO–UO_2–ZrO_2$, fabrication and properties as reactor fuel, 18: 21643(R) (WAPD-MRP-107)
$CaO–ZrO_2$, phase equilibria in, sub-solidus, 18: 20578
CALCIUM PHOSPHATES
strontium incorporation in precipitates of, 18: 19949
CALCIUM SULFIDES
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))
CALCIUM TANTALATES
luminescence of, self-activated, 18: 20060
CALCIUM ZIRCONATES
crystal structure of $CaZr_4O_9$, 18: 20020
CALCIUM ZIRCONIUM PHOSPHATES
preparation and structure, 18: 19944
CALDER HALL REACTORS
design and operation of Hunterston, 18: 21650
health and safety activities at Chapelcross, 1963, 18: 20236(R) (PG-Report-565)
CALIFORNIUM ISOTOPES Cf-246
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
CALIFORNIUM ISOTOPES Cf-248
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
CALIFORNIUM ISOTOPES Cf-250
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
CALIFORNIUM ISOTOPES Cf-252
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
fission of, angular distributions of prompt gamma rays emitted in, 18: 21706(R) (KR-66)
fission of, neutron distributions from, 18: 21197 (KR-64(Sect.XVIII))
CALORIMETERS
design and performance of isochronal differential micro-, 18: 20309
design and use in radiation chemistry of aqueous solutions, 18: 20083
development for measuring mixed radiation fields in reactors, 18: 20379
CALORIMETRY
methods of, for analysis, improving sensitivity of, 18: 21709(R) (MLM-1179)
CANADA
strontium-90 content in diet, 1953 through 1961, 18: 20235 (NP-13868)
CAPRYLIC ACIDS, THIO-
protective effects in rats against radiotherapy for Walker carcinomas, 18: 19798
CARBON
content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)
content in stellar red giants, mechanisms for, 18: 20727
deposition of coatings of, on fuel particles, 18: 20450(R) (BMI-1661 (Del.))
determination in plutonium and uranium carbides, 18: 19902
determination in zirconium diboride, 18: 19882
diffusion in refractory metals, conditions for, 18: 20540
effects in potassium-sodium reactor coolant, 18: 21661
fission gas release from coatings of, 18: 20450(R) (BMI-1661(Del.))
meson (π) diffraction dissociation on, 18: 20891 (AD-433625)
migration in uranium carbide induced by thermal gradient, 18: 20450(R) (BMI-1661(Del.))
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron total cross sections at 2.77 Mev, 18: 21159 (CEA-2399)
preparation of thin films of, by evaporation, 18: 20451 (CEA-2390)
radiation effects on thermal conductivity of pyrolytic, 18: 20450(R) (BMI-1661(Del.))
reactions of atomic, double tracer technique for study of mechanisms of, 18: 20022 (CONF-322-10)
reactions with zirconium hydrides and oxides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
removal from sodium primary system of HNPF, 18: 21637 (NAA-SR-Memo-8214)
CARBON DIOXIDES
determination in air, use of coaxial-symmetrical flow spark counter for, 18: 20348
electric discharge in, ion yields in glow, 18: 21455
heat of sublimation from sublimation point to 40°K, 18: 19933 (NP-13862)
performance as proportional-detector gas, 18: 20397
sorption on beryllium oxide, 18: 20014
spectra in mixtures with oxygen, negative ions in afterglow, 18: 21093
vapor pressure from sublimation point to 40°K, 18: 19933 (NP-13862)
$CO_2–N_2$, temperature dependence of dielectric loss properties of, 18: 20627(R) (NP-13815)
CARBON IONS
wave functions for $1s^22s2p^3$ configuration of, self-consistent, 18: 20759
CARBON ISOTOPES C-11
nuclear deformation parameters and energy levels for, 18: 21307
CARBON ISOTOPES C-12
alpha elastic scattering by, Regge poles and resonances in, 18: 21332
alpha elastic scattering at 65 Mev, 18: 21260
bremsstrahlung reactions (γ,n) with, 18: 21328
energy levels, 18: 21306
gamma reactions (γ,3α) up to 24 Mev, 18: 21224
gamma reactions (γ,p) up to 45 Mev, cross sections for, 18: 21163 (CONF-481-4)
gamma reactions (γ,pt) at 30 to 80 Mev, nucleon cluster model of, 18: 21247
helium-3 reactions (He-3,n) with, cross sections and yields in, 18: 21336
helium-3 reactions (He^3,n) at 5.5 to 11 Mev, 18: 21259
meson (π^-) reactions (π^-,π^-n) at 0.45 to 1.9 Bev, excitation function for, 18: 21293
nuclear deformation parameters and energy levels for, 18: 21307
nuclear quadrupole transition in, ground-state correlations for, 18: 21253
proton elastic scattering by, polarization in, 18: 21300
proton inelastic scattering at 10.3 Mev, 18: 21252
proton inelastic scattering at 8.5 Mev, 18: 21254
separation from carbon-14 by thermal diffusion in carbon monoxide, 18: 20435
CARBON ISOTOPES C-13
energy level transition rates in, single-particle, 18: 21253
helium-3 reactions (He^3,n) at 7.5 to 11 Mev, 18: 21259
lithium-6 reactions (Li^6,α) at 3.4 to 4.0 Mev, differential cross sections for, 18: 21295
nuclear deformation parameters and energy levels for, 18: 21307
proton reactions (p,n) with, threshold energy for, 18: 21284
proton reactions (p,γ) with, nitrogen-14 decay from, 18: 21261
separation from other carbon isotopes by thermal diffusion in methane and carbon monoxide, 18: 21707(R) (MLM-1177)
separation from other carbon isotopes by thermal diffusion in methane, 18: 21708(R) (MLM-1178)
separation from other carbon isotopes by thermal diffusion in carbon monoxide and methane, 18: 21709(R) (MLM-1179)
CARBON ISOTOPES C-14
age determination of humus podzols using, 18: 20223
detection of, efficiency of scintillation, 18: 20352
determination in mixtures with phosphorus-32 or tritium, conditions for two-channel liquid scintillation, 18: 19873
determination in tritium mixture by liquid scintillation counting, statistics of, 18: 19872
nuclear deformation parameters and energy levels for, 18: 21307
production in atmosphere by solar-proton-produced neutron reactions with nitrogen-14, 18: 20817
radiation effects on rabbit metabolism of, palmitic acid labeled with, x, 18: 19665
separation from carbon-12 by thermal diffusion in carbon monoxide, 18: 20435
synthesis of α-DL-alanine labeled with, 18: 20033
CARBON MONOXIDES
desorption from molybdenum surface by slow-electron impact, 18: 20641
heats of sublimation and vaporization from boiling point to 14°K, 18: 19933 (NP-13862)
isotope separation by thermal diffusion in, 18: 20435
radiolysis in presence of rare gases with and without application of electric field, 18: 20087
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
thermal diffusion of carbon-13 in, 18: 21707(R) (MLM-1177)
thermal diffusion of carbon-13 in, 18: 21709(R) (MLM-1179)
vapor pressure from boiling point to 14°K, 18: 19933 (NP-13862)

CARBON SULFIDES
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
CARBON SYSTEMS
C–Mo–Ti–Zr, dispersed phase studies in Mo-TZC, 18: 20512 (ASD-TDR-62-7(Pt.II))
C–Pu, phase diagram of, dilatometric studies on, 18: 20522 (LADC-5788)
C–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))
CARBON TETRACHLORIDE
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
diffusion coefficients for gases in, 18: 19963
radioinduced reactions with white phosphorus, gamma and neutron, 18: 20091
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
CARBON TETRAFLUORIDE
diffusion coefficients in carbon tetrachloride, 18: 19963
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
CARBONATES
metabolism of, in marine mollusks and bacteria, 18: 19520(R) (TID-20499)
CARCINOGENESIS
incidence of, in Hiroshima and Nagasaki, 18: 19581
mutation theory of, 18: 19505 (BNL-7912)
radioinduced in Hiroshima and Nagasaki populations, 18: 19580
radioinduced in rats, x, 18: 19587
CARCINOMAS
radiation effects on nuclear diameter of cells in Walker, 18: 19699
radiation effects on alkaline phosphatase activity of cells of, 18: 19701
radiotherapy for cervical, pregnancy following, radium and x, 18: 19565
radiotherapy of breast, effects on bones, gamma and x, 18: 19673
radiotherapy of cervical, protective effects of oxytetradine against febrile reactions in, 18: 19792
radiotherapy of rat, protective effects of chemicals in, 18: 19798
radiotherapy of urinary bladder, 18: 19827
radiotherapy of uterine, radioinduced osteonecrosis of femur in, 18: 19713
radiotherapy of, on skin or lips, development of radioinduced ulcers in, 18: 19714
CAROLINAS-VIRGINIA TUBE REACTOR
development and operation, Oct.-Dec. 1963, 18: 21630(R) (CVNA-202)
operation, Mar. 1964, 18: 21631(R) (CVNA-203)
CARTILAGE
radiation effects on, in larynx of growing rabbits, 18: 19700
CASCADE SHOWERS
branching procers in, convergence of random distribution function for, 18: 20892 (AD-434059)
fluctuation problems in electromagnetic, 18: 20978
production in lead, bubble chamber measurements of, 18: 20669
research progress on, 18: 21712(R) (NYO-10065)
CATALASES
radiation effects on *Mycobacterium tuberculosis*, x, 18: 19607
CATHODES
electric space charge of, in electron beam interactions with plasma, 18: 21453
electron emission by, in helium discharge, 18: 21452
ion reactions with discharge tube, electron emission in, 18: 20137
temperature distribution of, in electron heating loop for liquid metal, 18: 20183 (TID-18835)
CATION EXCHANGE MATERIALS
selectivity of Dowex 50 X8 in ammonia, effects of anions on, 18: 19837(R) (MIT-905-1)
sorptive properties of Dow ET-561, Dowex 50W, and Wiley X8 for hydrogen and sodium ions, 18: 19837(R) (MIT-905-1)
CATTLE
calcium-45, phosphorus-32, and strontium-89 content in blood plasma of, method for establishing constant, 18: 19541
radiation effects on tendon of, effects of cysteine, drying, hydration, and tanning on, 18: 19629
CAVES
design modification of promethium-147, to meet neutron attenuation requirements, 18: 20134(R) (ORNL-TM-792)
personnel safety interlock system for, 18: 20134(R) (ORNL-TM-792)
sample and waste removal system for, 18: 20134(R) (ORNL-TM-792)
weighing equipment for, 18: 20134(R) (ORNL-TM-792)
CAVITATION
in mercury, void fraction measurements using gamma densitometer, 18: 20167 (NP-13812)
production in liquid helium by ultrasonics, 18: 20678
CAVITY RESONATORS
electric discharge in, time variation of resonant frequency in, 18: 21475
radiation of homogeneous system in multimode, theory of stationary, 18: 20310
resonance frequencies of, in accelerated system of reference, 18: 20652
CENTRIFUGES
design for corrosion product separation, 18: 21675 (NP-13795)
CERAMIC MATERIALS
corrosion by cesium at 750°C, 18: 20873
dielectric failure mechanisms in, 18: 20526(R) (RADC-TDR-63-269)
CERIUM
content and relative abundances in terrestrial materials, 18: 20202
determination in thorium using xylenol orange, spectrophotometric, 18: 19883
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
electron structure of, measurement from positron annihilation, 18: 20552
phase studies of, critical end point for low- and high-pressure, 18: 20551
preparation of high-purity, method for, 18: 19996
reactions with potassium ferrocyanide, potentiometric, 18: 20106
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from fission products by sorption on ferric hydroxide, 18: 20102 (UJV-850/63)
separation from lanthanum and praseodymium using bis(2-ethylhexyl) orthophosphoric acid, chromatographic, 18: 20109
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
voltammetry in phosphoric acid–sulfuric acid or sulfuric acid using pyrolytic graphite electrode, 18: 19967
CERIUM ALLOYS
Ce–Y, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
CERIUM CHLORIDES
effects on blood coagulation, 18: 19535
CERIUM COMPLEXES
with arsenazo, composition of, 18: 19948
CERIUM HYDRIDES
reactions with cerium oxides and sulfides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
CERIUM ISOTOPES Ce-137
electron conversion spectra of isomeric, 18: 20376
CERIUM ISOTOPES Ce-139
gamma spectrum from aligned, plane polarization in, 18: 21274
CERIUM ISOTOPES Ce-140
energy level at 2083 kev (4⁺), g-factor for, 18: 21286
energy levels of, spins and parities of, 18: 21208 (NP-13841)
nucleon binding energies, energy levels, and potentials for, 18: 21358
CERIUM ISOTOPES Ce-141
energy levels of, spins and parities of, 18: 21208 (NP-13841)
gamma spectrum from aligned, plane polarization in, 18: 21274
CERIUM ISOTOPES Ce-142
energy levels, 18: 21270
neutron reactions (n,γ) with, production of carrier-free praseodymium-143 by, 18: 20071
CERIUM ISOTOPES Ce-144
distribution of intravenously injected, in mice, effects of sex on, 18: 19545
metabolism by mice after inhalation in liquid aerosol, 18: 19544
separation from water by chemical precipitation, 18: 20266
uptake from soil by crop plants, 18: 19515 (NP-13796)
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
CERIUM NITRATES

oxidation by ozone in nitric acid solutions, 18: 19924 (AERE-R-4537)
solubility polytherms of systems with other ceric earths, 18: 20108

CERIUM OXIDES
analysis for oxygen, 18: 19907
reactions with cerium hydrides and sulfides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
CeO_2–UO_2, radiation effects on, 18: 20450(R) (BMI-1661(Del.))

CERIUM OXYSELENIDES
preparation and properties of hydrogen bonding in, 18: 19981

CERIUM OXYSULFIDES
preparation and properties of hydrogen bonding in, 18: 19981

CERIUM SULFIDES
reactions with cerium hydrides and oxides at 1000 to 1600°C, hydrogen bonding in, 18: 19981

CERMETS
thermal expansion of titanium carbide-type, at 68 to 1800°F, 18: 20513 (CNLM-4234)
thermal expansion of thirteen tungsten carbide, at 68 to 1800°F, 18: 20514 (CNLM-4479)

CESIUM
content in Atlantic, Indian, and Pacific Oceans, variations in, 18: 20220
corrosive effects on thermionic cell materials, 18: 20873
determination in minerals and rocks, spectroscopic, 18: 19853(T) (CEA-tr-R-1711)
electron reaction at low energies, cross sections for, 18: 20773
electron reactions with atoms of, cross section measurement by microwave spectrometry, 18: 21379(R) (N63-13602)
electron structure, 18: 20548
ion-atom reactions at 0.1 to 10 ev, cross sections for, 18: 20772
ionization and resonance absorption in thermionic cells, processes for, 18: 20853
ionization by electron impact, calculation of cross section near threshold for, 18: 20779
ionization in thermionic cells, mechanisms for volume, 18: 20850
performance in parallel-plane thermionic cells, 18: 20855
performance in thermionic cells, current-voltage data for, 18: 20844
performance in thermionic cells, models for, 18: 20848
performance in thermionic cell ignited mode, current-voltage characteristics for, 18: 20849
performance in thermionic cells, energy transfer in, 18: 20852
performance in thermionic cell power generation, 18: 20854
plasma of, charged-particle currents and temperatures in, 18: 21438
plasma of, containment in magnetic fields, 18: 21389 (TID-20509)
plasma of, electron cyclotron resonance absorption spectra in magnetic field, 18: 21379(R) (N63-13602)
production of high-purity, 18: 20117(P)
properties as ion engine fuel, effects of potassium and sodium on, 18: 20626(R) (NP-13800)
reactions with cesium ions at 0.1 to 10 ev, modification of Ramsauer apparatus for measuring cross sections of, 18: 21379(R) (N63-13602)
separation by solvent extraction, 18: 19837(R) (MIT-905-1)
separation from waste solutions by ion exchange, 18: 20097 (CONF-179-1)
sorption by potassium cobalt ferrocyanide, 18: 20097 (CONF-179-1)
thermionic properties in diodes, 18: 21367(R) (AD-429133)
thermodynamic properties of liquid, at temperatures to 2000°F, 18: 19925(R) (AGN-8065)
vapor pressure, 18: 20829(R) (AD-429503)

CESIUM ALLOYS
Sb–Cs, performance as collector for thermionic cells, 18: 20870

CESIUM COMPOUNDS
production of high-purity, 18: 20117(P)

CESIUM ELECTRODES
ion emission by, current-voltage curves for, 18: 20843

CESIUM HYDRIDES
vapor pressure of hydrogen over, 18: 20829(R) (AD-429503)

CESIUM IONS
emission by thermionic cathodes, current-voltage curves for, 18: 20843
emission by tungsten cathodes, properties of thermal, 18: 20842
production and acceleration by contact ionization on porous tungsten, hot-wire calorimeter study of, 18: 20289
reactions with cesium atoms at 0.1 to 10 ev, modification of Ramsauer apparatus for measuring cross sections of, 18: 21379(R) (N63-13602)
reactions with cesium atoms at 0.1 to 10 ev, cross sections for, 18: 20772
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)

CESIUM ISOTOPES Cs-134
beta decay of, circular polarization of gamma radiation following, 18: 21309

CESIUM ISOTOPES Cs-135
parity and spin of 53-min, 18: 21265

CESIUM ISOTOPES Cs-137
body burden in Alaska, 18: 20231 (HW-SA-3048)
content in animals and plants of Lapland, 18: 20213
content in Clinch and Tennessee Rivers from ORNL, 18: 21697
content in milk in German Federal Republic, Sept. 1961 to Sept. 1962, 18: 19809
content in milk in England, 18: 20208 (AERE-R-4415)
content in milk samples collected in New Zealand, 1963, 18: 20234(R) (NP-13859)
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
determination in fallout by ion exchange, 18: 19880
gamma spectrum at 0.1 to 2 Mev, 18: 20411
scintillator quenching by, 18: 20352
separation from water by chemical precipitation, 18: 20266
uptake by rats, effects of ferric cyanoferrate(II) on, 18: 19534
uptake from soil by crop plants, 18: 19515 (NP-13796)
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516

CESIUM NITRATES
effects on chloride association with silver in, constants for, 18: 19975
$CsNO_3$–KNO_3, effects on chloride association with silver, 18: 19975

CESIUM OXIDES
performance as collector for thermionic cells, 18: 20870
vapor pressure of oxygen over, 18: 20829(R) (AD-429503)
CsO–Au, electron emission from discharge cathodes of, 18: 21452

CESIUM TELLURIDES
performance as collector for thermionic cells, 18: 20870

CHARCOAL
sorptive properties for radon, 18: 19940(T) (SC-T-64-613)

CHARGED PARTICLE BEAMS
analysis using magnets, effects of fringing fields on, 18: 20644
energy of, method for obtaining homogeneity of, 18: 20706
motion in achromatic quadrupole lenses, 18: 20686
oscillations of accelerated, effects of external interference on phase, 18: 20700
oscillations of accelerated, harmonic linearization of phase, 18: 20701
production of accelerated, determination of duty factor of pulse generator for, 18: 20684
profile display for, using semiconductor detectors, 18: 20327 (BNL-7880)
separation of fast, using h-f electromagnetic fields, 18: 20925
stability in cyclotrons, longitudinal, 18: 20702

CHARGED PARTICLES
detection and measurement in aurorae, 18: 20364
emission from bombarded electrodes, 18: 20665
energy gains in plasma with r-f field, 18: 21520
injection into static magnetic mirror configuration, longitudinal, 18: 21370 (CEA-R-2410)
intensity distribution in line focus of spectrometer, wave optics of, 18: 20407
interactions of, algebra of charges in, 18: 20981
motion in an axisymmetric magnetic barrier, nonadiabatic, 18: 21449
motion in axisymmetric magnetic fields, 18: 20645
motion in Coulomb fields, 18: 21027
motion in electromagnetic fields at cyclotron resonance, 18: 21383 (NP-13852)
motion in upper atmosphere, electrodynamics of, 18: 21078
production by thermal reactions in ionosphere, 18: 21092
pseudoscalar charge density of spin-½, observability of, 18: 20946
spin precession in inhomogeneous electromagnetic field, approximate relativistic equations of motion for, 18: 20646

trajectories in electromagnetic and magnetic fields in plasma, 18: 21521
trajectories in magnetic fields, computer program for calculating, 18: 20682 (TID-20563)
trajectories of, apparatus for measuring, 18: 21022(P)
trapping in magnetic mirror machine, 18: 21370 (CEA-R-2410)

CHEMICAL ANALYSIS
bibliography on detectors for, 18: 19847 (LAMS-2378(Vol.II))
contamination in, strontium, 18: 19888
developments in gravimetric and volumetric analysis for inorganic compounds, review of, 18: 19865
developments in kinetic aspects of, review of, 18: 19868

CHEMICAL ENGINEERING
optimization of two-stage tank reactor system, 18: 20156

CHEMICAL PROPHYLAXIS
effects of Tanderil (oxyphenylbutazone) on rat submucosal tissue, 18: 19803
for radiation injuries, review of agents and mechanisms for, 18: 19791
in mice of propyl gallate, α-tocopherol, and α-tocopherolacetate, 18: 19797
of radiation injuries, mechanisms for, 18: 19771
protein-bonding of bis(2-guanidoethyl) disulfide in, 18: 19773

CHEMICAL RADIATION DETECTORS
materials for, properties of ammonium nitrate as, 18: 20080
performance of carbon tetrachloride-ferrocene solutions in, for gamma dosimetry, 18: 20402
use of iodoacetic acid–starch mixture as, 18: 19751

CHEMICALS AND REAGENTS
bibliography on analytical, 18: 19847 (LAMS-2378(Vol.II))

CHEMISTRY
Mössbauer effect in, review on, 18: 19998
of rare gases, 18: 19997
research progress on, 18: 21712(R) (NYO-10065)
spectrometry in, review of light absorption, 18: 19860

CHEMOTHERAPY
for malignant diseases, protective effects of autologous bone marrow transfusions following, 18: 19768

CHERENKOV DETECTORS
design of liquid-hydrogen, 18: 20369

CHERENKOV RADIATION
emission from anisotropic ferrites, 18: 20775

CHICKENS
effects on fertility and hatchability of gamma-irradiated sperm in, 18: 19664
radiation effects on morphogenesis of tibiotarsus in embryonic, 18: 19657

CHINLE FORMATION (UTAH)
mineralogical changes in uranium deposit sediments in, mechanism of, 18: 20228

CHINON REACTORS
environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)

CHLORIDE COMPLEXES
with manganese in perchlorate solutions, paramagnetic resonance studies of, 18: 21730 (UCRL-10446)

CHLORIDE IONS
association with silver in liquid cesium, lithium, and potassium nitrate mixtures, constants for, 18: 19975
effects on isotopic exchange between iodine and o-iodoanisole, 18: 19964

CHLORIDES
corrosive effects on 18-8 stainless steel in dilute solutions, effects of acidity on, 18: 20471 (CONF-492-2)

CHLORINE
content in marine atmosphere, 18: 19837(R) (MIT-905-1)
determination in lubricants, computer routine for activation, 18: 19918
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
effects on hydrogen yields in radiolysis of hydrobromic acid-hydrochloric acid and hydrochloric acid, 18: 20062
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)

CHLORINE IONS
bleaching of radioinduced Cl_2^-, in x-irradiated lead-doped potassium chloride, 18: 20038 (COO-1044-13)

CHLORINE ISOTOPES Cl-34
beta decay of, half life for, 18: 21306

CHLORINE ISOTOPES Cl-35
neutron reactions (n,γ) with, angular distributions of electron-positron pairs from, 18: 21236
proton reactions (p,γ) at 0.4 to 1.0 Mev, 18: 21264

CHLORINE ISOTOPES Cl-36
content in meteorites, 18: 20815 (BNL-7948)
determination in iron meteorites, 18: 20221

CHLORINE ISOTOPES Cl-37
neutron reactions (n,γ) with, in chlorinated methanes, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)

CHLORINE ISOTOPES Cl-38
reactions of recoil, with hydrocarbons and halogenated hydrocarbons, 18: 20041 (MMPP-167-6)

CHLOROFORM
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)

CHLOROPHYLLS
content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)

CHLOROPLASTS
contribution to cell-free viral synthesis of bean, 18: 21725(R) (TID-20437)

CHOLINE, ACETYL-
radiation effects on content of, in dog blood, 18: 19683

CHOLINESTERASES
radiation effects on activity of, in dog blood, 18: 19683

CHROMATOGRAPHY
gas, constant-flow regulator for, 18: 20041 (MMPP-167-6)
gas, device for integrating activity under each peak, 18: 20041 (MMPP-167-6)
gas, programmed temperature regulator for, 18: 20041 (MMPP-167-6)
ion exchange materials in, review of, 18: 19857
methods in thin-layer, 18: 19854(T) (SC-T-64-49)
ultraviolet radioactivity of eluants from column, continuous-flow analyzer for recording, 18: 19870

CHROMIUM
determination in fluoride salts by amperometric titration, 18: 19869
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
effects on spalling of niobium at high temperatures, 18: 20474 (TID-12794)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
voltammetry in phosphoric acid–sulfuric acid or sulfuric acid using pyrolytic graphite electrode, 18: 19967

CHROMIUM ALLOYS
Al–Cr–Ni–Ti, corrosion of Inconel 702 by superheated steam, 18: 21668(R) (GEMP-274)
Cr–Mo–Ni, corrosion of Incoloy and Timken 16-25-6, by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
Cr–Mo–Zr, corrosion by pressurized water and workability of, 18: 20461
Cr–Mo–Zr, heat treatment effects on mechanical properties and microstructure of, 18: 20461
Cr–Ni, creep properties, 18: 21668(R) (GEMP-274)
Cr–Ni, oxidation by air and steam, 18: 21668(R) (GEMP-274)
Cr–Rh–Ti, superconductivity, 18: 21112

CHROMIUM CARBIDES
entropy of formation at 298°K, 18: 19974

CHROMIUM ISOTOPES Cr-52
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291

CHROMIUM ISOTOPES Cr-53
electron paramagnetic resonance in zinc compounds, parameters for, 18: 20019
energy level crossings in, 18: 20627(R) (NP-13815)

CHROMIUM ISOTOPES Cr-54
energy levels of, spins and parities of, 18: 21208 (NP-13841)

CHROMIUM OXIDES
sorptive properties for protactinium, 18: 20105
CHROMIUM SILICIDES
magnetic susceptibility, 18: 20541
CHROMIUM SYSTEMS
B–Cr–Ni, corrosion by cesium at 750°C, 18: 20873
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
Cr–Mo–Si, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)
Cr–Si–Ti, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)
CHROMOSOMES
radiation effects on hamster lung cell, x, 18: 19670
radiation effects on, in *Hymenolepis diminuta*, gamma, 18: 19752
radiation effects on B^1, in maize, 18: 19513
radioinduced aberrations of, in human skin cultures, 18: 19563
radioinduced aberrations of, method for radiation detection and dosimetry using, x, 18: 19643
radioinduced aberrations in, in man, gamma and neutron, 18: 19582
radioinduced abnormalities of, in man and mouse, 18: 19583
radioinduced and chemical aberrations in, mechanisms for, 18: 19559
tritium-labeled *Vicia faba*, 18: 19518 (BNL-7007)
CHYMOTRYPSIN
radiation effects on kinetics of, uv and x, 18: 19666
CIRCUITS
description of transistorized fail-safe high-low trip, 18: 20292
design for improving resolution in time-of-flight many-layer neutron spectrometer, 18: 20338 (PAN-469/I)
design of pulse-voltage-dividing, 18: 20358
radiation effects on, transient, 18: 20321
CIVIL ENGINEERING
radioisotopes in highway construction, 18: 20120
CIVILIAN DEFENSE
contamination of municipal water facilities by nuclear attacks, 18: 20233 (NP-13806)
mass casualty treatment in, 18: 20258
CLAYS
sorptive properties for radioactive wastes from organic coolants, radiometric determination of saturation in, 18: 21553 (NAA-SR-memo-7771)
sorptive properties for strontium-90 in radioactive solutions, 18: 21696
CLINCH RIVER
flow studies of, use of analog computer in, 18: 20134(R) (ORNL-TM-792)
radioisotopes in, biological, chemical, and physical effects of, 18: 21697
CLOUD CHAMBERS
design of helium-3-filled, 18: 20390
COAL
rare earth content and relative abundances in, 18: 20202
use in power plants, radioactivity in atmosphere from, 18: 20265
COATINGS
deposition by flame spraying, 18: 20134(R) (ORNL-TM-792)
deposition on fuel particles, 18: 20450(R) (BMI-1661(Del.))
development of vapotron, for reactor fuels, 18: 21617 (TID-7694(p.71-84))
emittance and surface temperature of oxide to, 18: 20565
COBALT
alloying effects on corrosion of magnesium–neodymium alloys, 18: 20482
determination by chelating radiometric titration using EDTA, 18: 19899
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in presence of iron by sorption of cobalt phenanthroline on silicon oxide, 18: 19898
determination in solutions, differential spectrophotometric, 18: 19842 (EUR-581.f)
exchange in chelating ion resin, self-, 18: 19972
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
COBALT ALLOYS
Co–Pd, corrosion by cesium at 750°C, 18: 20873
Co–Rh–Ti, superconductivity, 18: 21112
COBALT COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946
with 1,10-phenanthroline, sorption on silicon oxide, 18: 19898
COBALT ISOTOPES Co-54
beta decay of, half life for, 18: 21306
COBALT ISOTOPES Co-56
beta decay of, circular polarization of gamma radiation following, 18: 21309
COBALT ISOTOPES Co-57
energy levels of, spins and parities of, 18: 21208 (NP-13841)
COBALT ISOTOPES Co-58
beta decay of, circular polarization of gamma radiation following, 18: 21309
COBALT ISOTOPES Co-59
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
COBALT ISOTOPES Co-60
beta decay of, circular polarization of gamma radiation following, 18: 21309
content in Clinch and Tennessee Rivers from ORNL, 18: 21697
irradiation facility, design of, featuring air induction, 18: 20419
preparation and properties for gamma radiography, 18: 20421
separation from water by chemical precipitation, 18: 20266
therapy of breast carcinomas using, effects on bones, 18: 19673
COBALT SYSTEMS
Co–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Co–NbC–TaC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–NbC–TaC–TiC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
COINCIDENCE COUNTERS
corrections of, comparison of double-source and multiple-source methods, 18: 21708(R) (MLM-1178)
design and performance of solid-state fast-slow system with multichannel time display, 18: 20345
design for scintillation gamma spectroscopy, 18: 20331 (KR-64(Sect.X))
development of, review of, 18: 20406
efficiency of, effects of geometry on, 18: 20382
COINCIDENCE MEASUREMENTS
analysis of sum-, for detection of fictitious gamma cascades, 18: 21251
COLLIMATORS
design, construction, and testing of, for radioisotope-scanning systems, 18: 20416
development of steel, for 14-Mev neutron source, 18: 19821
neutron reflection from walls of, multiple, 18: 21126 (KR-64(Sect.XXIV))
COLLOIDS
preparation of labeled serum albumin, for use in pathema localization by photoscanning, 18: 19813 (CONF-164-11)
COLUMBIA RIVER
sediment radioactivity, 18: 20219
COMMUNICATION SYSTEMS
use of multiplex techniques in, for accelerators, 18: 20280 (CERN-64-21)
COMPTON EFFECT
theory of nonstationary multiple Compton scattering of gamma quanta, 18: 20920
COMPUTER PROGRAMS
Beam design, for calculating charged-particle trajectories, 18: 20682 (TID-20563)
CAPRI A.B., for calculating thermal utilization factors, 18: 21597 (EUR-1606.e)
description of, for analysis of helium-3 neutron spectrometer results, 18: 20359
FIRED, integer data relative read routine for FSM-1 data reduction, 18: 20439 (NAA-SR-Memo-9683)
for calculating cascade stagewise conditions for rare earth separation by solvent extraction using TBP, IBM 7074, 18: 20098 (IS-780)
for determining plasma density from hydrogen spectral lines, 18: 21369 (ATN-64(9233)-8)

for HNPF data reduction and analysis, 18: 21640 (NAA-SR-Memo-9391)
for IBM data tabulation on radium pathology, 18: 19550 (NYO-2181-1)
for Monte Carlo solutions to gamma transport problems on Ferranti Mercury Computer, 18: 20932
for multichannel two-dimensional two-phase coolant flow in boiling water reactors, discontinuous nodal flow model approximation for IBM 7090, 18: 21557 (NAA-SR-Memo-9444)
for neutron activation analysis, 18: 19918
for optimization of times of irradiation and decay in activation analyses, FORTRAN, 18: 19874
for thermionic diode performance evaluation, 18: 20884
GAPLSN, for one-dimensional anisotropic neutron and photon transport equations, 18: 21123 (GA-4972)
GRATIS, for calculating gamma transmission, 18: 21544 (BRL-Memo-1223)
least squares polynomial curve fit program subroutine with SC-4020 CRT display, 18: 21710 (NAA-SR-Memo-9638)
MAC, for reactor shielding calculations, constants and cross sections for, 18: 21545 (HW-73381(Suppl.1))
METHUSELAH I, for calculating burnup and parameters for liquid-moderated cells, 18: 21610 (AEEW-R-135)
SNAPKIN VI, for solving SNAP reactor kinetics equations, 18: 21669 (NAA-SR-9190)
SOFOCATE, for calculation of thermal spectra, comparison to other programs, 18: 21122 (EUR-1605.e)
THERMOS, for calculation of thermal spectra, comparison to other programs, 18: 21122 (EUR-1605.e)
THESIS II, for calculation of thermal spectra, comparison to other programs, 18: 21122 (EUR-1605.e)

COMPUTERS
CERN needs for, future, 18: 20438 (CERN-516 and Apps.)
performance of IBM 7090, for gamma spectral analysis, 18: 21248
pulse analyzer data handling by, 18: 20375
use as data-handling systems in physics research, 18: 21699 (BNL-7841)
use in calculating radiation dose distribution, 18: 19831
use in Clinch River and White Oak Creek flow studies, 18: 20134(R) (ORNL-TM-792)
use in determining influence of geometrical penumbra on shape of irradiation fields, 18: 19833
use of on-line, for data simulation in physics, 18: 21158 (BNL-7836)

CONCRETES
neutron streaming in ducts in, dosimetry of, 18: 21546 (NP-13805)
preparation and properties of high-density slag, 18: 20134(R) (ORNL-TM-792)
reactor housing structures of reinforced, 18: 21555 (NAA-SR-Memo-9429)
testing of spherical vessel of, for containing explosions, 18: 20130 (LADC-5817)

CONDENSERS
design for surplus steam in nuclear power plants, 18: 21663(P)

CONFERENCES
Advanced Course on Nuclear Physics with Thermal Neutrons, Kjeller, Norway, Sept. 1963, 18: 21185 (KR-64)
Astronomy and Physics of Meteors, Cambridge, August–September 1961, 18: 20710 (AFCRL-62-497)
Electron Tube Residual Gases, Second International, Milan, Mar. 12 to 15, 1963, 18: 20305
Industrial Waste, Proceedings of 17th, Purdue University, Lafayette, Ind., May 1-3, 1962, 18: 21693
Ionization Phenomenon in Gases, 6th International Conference on, Paris, July 1963, 18: 20671
Nuclear Emulsion Techniques with CERN Accelerators, St. Cergue, March 20–27, 1963, 18: 20895 (CERN-64-6)
Physical Factors and Modification of Radiation Injury, New York Academy of Sciences and Sloan Kettering Institute for Cancer Research, Nov. 29–Dec. 3, 1962, 18: 19569
Physics and Material Problems of Reactor Control Rods, IAEA Symposium, Vienna, Nov. 11 to 15, 1963, summary, 18: 21574
Quantum Electronics, Third International, Vols. I and II, Paris, Feb. 11 to 15, 1963, 18: 20316
Radiological Health and Safety in Milling and Mining of Nuclear Materials, Vienna, August 26-31, 1963, 18: 20267
Reactor Materials, Discussion Session of German Society of Metallography and Atomforum, Stuttgart, Dec. 9 and 10, 1963, summary, 18: 21558
Resonant States of Elementary Particles, Madras, India, Jan. 14–16, 1963, 18: 20993
Space Technology, Hertfordshire, England, Mar. 1 and 2, 1962, 18: 20673
Spectroscopy, 11th International Conference on, Belgrade, September 1963, 18: 20676
Thermionic Conversion Specialist Conference, Gatlinburg, Tenn., Oct. 1963, 18: 20841
Two-Phase Flow Problems, Meeting of Working Group on Heat Transfer, Brussels, Oct. 29 to 31, 1962, 18: 20168 (TID-7694)

CONNECTICUT YANKEE POWER REACTOR
design and hazards analysis of, 18: 21642 (NYO-3250-1)

COPPER
alpha scattering at 4 to 8 Mev, coulomb excitation study of single-particle core coupling in, 18: 21281
analysis for oxygen, activation, 18: 19886
chemical state and distribution coefficient of, in fused bismuth–lithium chloride–potassium chloride system, 18: 19983
determination in molybdenum, tungsten, and their alloys, classical methods for, 18: 19921
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in tantalum by d-c arc method, spectrographic, 18: 19894
diffusion in platinum, concentration gradients of, 18: 20512 (ASD-TDR-62-7(Pt.II))
effects on electric conductivity of x-irradiated alkali halides, 18: 20588
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
electron slowing down spectrum in, from copper-64, 18: 20732 (TID-20561)
exploding wire phenomena in, conductor configuration effects on vaporization in, 18: 21535
exploding wire phenomena with, energy shunting mechanisms in, 18: 21536
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359
hydrogen ion reactions at 260 kev, uv radiation emission in, 18: 20781
magnetic-field effects in, de Haas-van Alphen low, 18: 20755
pinch discharge on foils of, plasma production in Z, 18: 21537
proton reactions at 260 kev, uv radiation emission in, 18: 20781
radiation damage and annealing in, neutron, 18: 20599
radiation effects on, thermal activation of slip in neutron, 18: 20594
radiation effects on work hardening of single crystals of, neutron, 18: 20600
reflectance of crystalline, 18: 19837(R) (MIT-905-1)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
spectra of, wavelength of Kα, 18: 20653
sputtering by argon ions, 18: 20745
sputtering by argon at 40 to 80 kev, angular and energy distributions from, 18: 20783
sputtering by argon at 20 to 100 ev, atomic and diatomic yields in, 18: 20811
sputtering by krypton and mercury at 10 to 2000 ev, energy spectra and yields from, 18: 20787
sputtering by krypton at 100 to 600 ev, velocity distributions from, 18: 20788
sputtering by neon at 10 to 40 kev, temperature dependence of, 18: 20784
sputtering by xenon at 25 to 60 kev, energy dependence of, 18: 20785
stacking-fault energy, 18: 20550
xenon-131 ranges in, at 5 to 30 kev, 18: 20672

COPPER ALLOYS
Be–Cu, phase transitions in, oscillation damping in, 18: 20560
Cu–In, phase transitions in, oscillation damping in, 18: 20560
Cu–Rh–Ti, superconductivity, 18: 21112

COPPER CHLORIDES
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481

COPPER COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability

constants of, 18: 19946
COPPER ELECTRODES
electric breakdown between plane and plane-point geometries of, surface effects on, 18: 20141
plasma flow between, velocity of, 18: 21485
vaporization in vacuum arcs, 18: 20143
COPPER ISOTOPES Cu-63
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
energy levels of, E2 transition probabilities for coulomb-excited, 18: 21281
gamma reactions (γ,n) at 19 to 66 Mev, yields from, 18: 21308
proton elastic differential scattering cross sections, 18: 21171 (INSJ-68)
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
COPPER ISOTOPES Cu-64
beta decay in infinite copper body, electron spectrum from, 18: 20732 (TID-20561)
use in brain scanning, 18: 19817
COPPER ISOTOPES Cu-65
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
energy levels of, E2 transition probabilities for coulomb-excited, 18: 21281
proton elastic differential scattering cross sections, 18: 21171 (INSJ-68)
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
COPPER OXIDES
radiation effects on green and yellow excited absorption spectra of, 18: 20077
COPPER PERCHLORATES
$Cu(ClO_4)_2$–$NaClO_4$, osmotic pressure, 18: 19837(R) (MIT-905-1)
COPPER SULFATES
effects on oxidation of uranium dioxide, 18: 19943
$CuSO_4$–H_2SO_4–UO_2SO_4, corrosive effects on stainless steel, 18: 20477
COPPER SYSTEMS
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
COPPER URANATES
preparation and properties, 18: 20012
CORROSION LOOPS
design and development for studying refractory alloys in boiling and condensing alkali metals, 18: 20473(R) (NASA-CR-54008)
design for mercury corrosion testing, 18: 21675 (NP-13795)
tests of corrosion product separator in Haynes 25 Alloy loop containing mercury, 18: 21677 (TID-20552)
CORTICOSTERONES
radiation effects on rat blood content of, x, 18: 19676
CORTISONE
used with x radiation, effects on rabbit skin homografts, 18: 19613(T)
COSMIC ELECTRONS
detection and measurement of low-energy environmental, instrumentation for, 18: 20341 (TID-20564)
origin of, galactic, 18: 20826
COSMIC MESONS (μ)
intensity of, directional variations in, 18: 20819
COSMIC NEUTRONS
intensity and spectrum of, in vicinity of earth, 18: 20820
intensity dependence on latitude during cosmic-ray storm, 18: 20818
COSMIC NUCLEONS
interactions with nucleons at 30 to 10^4 Bev, particle production in, 18: 20969
reactions with aluminum above 10 Bev, 18: 21207 (NP-13839)
COSMIC PARTICLES
acceleration of, magnetic pumping model for, 18: 20823
detection and measurement of, U. S. program for, 18: 21090
intensities of heavy, modulation of, 18: 20813 (AD-434176)
interactions of, detector array for studying, 18: 20325(R) (AROD-2427:1)
motion of geomagnetic field effects on, 18: 20822
COSMIC RADIATION
book: *Cosmic Rays, Solar Particles and Space Research*, 18: 20821
distribution in charge, energy, and space, 18: 20824
electron content in galactic, 18: 20826
intensity measurement on, proposed, 18: 20828
intensity variation of, solar wind dependence of, 18: 20814 (AD-434540)
intensity variations of, spatial and temporal, 18: 20815 (BNL-7948)
interactions of, nuclear emulsion studies of, 18: 20901 (CERN-64-6 (p.125-42))
interactions with inner solar system, evidence for, 18: 20819
magnitude of storms of, dependence on geo-latitude, 18: 20818
origin, 18: 20825
origin, 18: 20827
origin of primary, theory of, 18: 20824
production in sun and solar system, 18: 20723
reactions with iron, magnesium, silicon, and sulfur in stony meteorites, production of helium-3 and neon-21 by, 18: 20204
reactions with nuclei at high energies, experimental measurement of, 18: 21209 (NP-13842)
reactions with stratospheric nuclei, radioisotope production in, 18: 21080
research progress on, 18: 21712(R) (NYO-10065)
shielding from, in space vehicles, 18: 20240
use in elementary particle research on strong interactions, 18: 20968
COSMIC SHOWERS
properties of extensive, 18: 20825
COSMOLOGY
evolution of solar system and expansion of universe, 18: 20712
spherically symmetric space-times in, 18: 20658
COTTON
radiation effects on seedlings of, gamma, 18: 20418
radioinduced graft polymerization with polyacrylonitrile and polystyrene, thermal stress properties of products in, 18: 20084
COUNTERCURRENT SEPARATION PROCESSES
efficiency for isotope separation, 18: 20433
mass effects on ion migration in electrolytic, 18: 20112
COUNTING DEVICES
design of binary-decimal and octal-decimal converter, 18: 20301
CRATERS
formation by high-explosive sources in desert alluvium, calculation, 18: 20123 (UCRL-7738)
CRITICAL ASSEMBLIES
design of mockups in ETR facility for studies of boric acid solutions, 18: 21565 (IDO-16812)
hazards analysis for ZPR-VI, 18: 21592 (ANL-6271)
neutron physics of slightly enriched water-moderated, 18: 21594 (BNL-6975)
nuclear physics measurements in ZPR-IV, 18: 21698(R) (ANL-6860)
operation and testing of ZPR-IX, 18: 21698(R) (ANL-6860)
operation of ZPR-III, 18: 21698(R) (ANL-6860)
CRITICALITY STUDIES
buckling in two-region system, 18: 21606
experiments on 630A Maritime Nuclear Steam Generator mockup, 18: 21668(R) (GEMP-274)
CROSS SECTIONS
approximation method based on R-matrix theory for, 18: 21304
calculation of differential, in small-angle molecular beam scattering, 18: 20736
for atom-atom scattering, resonance behavior of, 18: 20765
library of, for reactor analysis, 18: 21551 (GEMP-283)
statistical theory of nuclear collision, 18: 21698(R) (ANL-6860)
tables of gamma production, 18: 21169 (GEMP-278)
theory of, using irreversible statistical mechanics of moderately dense fluids, 18: 20633 (TID-20512)
CRYOGENICS
development, 18: 21095(R) (NBS-8239)
in vacuum irradiation of engineering materials, 18: 20581(R) (FZK-172)

stability of film-boiling two-phase flow in cryogenic systems, 18: 21119
CRYOSTATS
description of simple low-temperature chamber using liquid nitrogen injection, 18: 21729 (UCRL-7349)
design for regulation of bubble-chamber temperature, 18: 20367
CRYSTAL STRUCTURE
book: *Point Defects in Metals*, 18: 20568
dislocation loops in, electron microscopic determinations of, 18: 20546
dislocation loops in, elastic energy of rhombus-shaped, 18: 20547
electron-phonon interactions in, field theory of, 18: 21066
lattice plane observations in, use of electron microscope for, 18: 20319
stacking-fault energy of pure fcc metals, 18: 20550
CRYSTALS
lattice vibrations of rock-salt, eigenvectors for, 18: 21726 (TID-20487)
neutral-particle scattering by, theory of momentum exchange in elastic, 18: 21342
nuclear quadrupole resonance and Zeeman effect in, equipment for detecting, 18: 19994
polaron energy in ionic, Monte Carlo method for calculating, 18: 21737(T) (UCRL-Trans-1040(L))
CURIUM ISOTOPES Cm-240
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
CURIUM ISOTOPES Cm-242
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
CURIUM ISOTOPES Cm-244
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
fission of, emission of alpha particle in spontaneous, 18: 21222
CURIUM ISOTOPES Cm-246
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
CURIUM ISOTOPES Cm-247
determination in euxenites, 18: 20217
CURIUM ISOTOPES Cm-248
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
CUTLER FORMATION (UTAH)
mineralogical changes in uranium deposit sediments in, mechanism of, 18: 20228
CUTTING TOOLS
design for cutting crystals and glass, 18: 20134(R) (ORNL-TM-792)
wear measurement by scintillation technique, radiometric method for, 18: 20426
CYANIDES
radioprotective effects of, mechanism for, 18: 19771
1,3-CYCLOHEXADIENE
radioinduced reactions of, to form Diels-Alder adducts, 18: 20088
CYCLOHEXANE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
radiolysis of adsorbed, effects of zeolite composition on yields in, 18: 20051
radiolysis of, mechanism of hydrogen formation in, 18: 20057
cyclohexane-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
CYCLOHEXENE
cyclohexene-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
CYCLONE SEPARATORS
design and development of centrifugal, for air-water and steam-water systems, 18: 20128(R) (ACNP-64021)
theory, 18: 21707(R) (MLM-1177)
CYCLOOCTATETRAENE
reduction polarographic, 18: 19837(R) (MIT-905-1)
CYCLOPENTANE
radiolysis of, mechanism of hydrogen formation in, 18: 20057
CYCLOPENTANONE
radiolysis of gaseous and liquid, 18: 20093
benzene-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
cyclohexane-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
cyclohexene-cyclopentanone, radiolysis of, yields of gaseous products in, 18: 20093
CYCLOPENTENE
1,2-dimethyl, synthesis, 18: 19837(R) (MIT-905-1)
CYCLOPROPANE
radical anion formation in saturated, 18: 19837(R) (MIT-905-1)
CYCLOTRON RADIATION
electron optical, in magnetic field of M82 galaxy, 18: 20718
emission from plasma, single-particle, 18: 21417
CYCLOTRONS
beam scattering-chamber design for F-M, 18: 20688
beam stability in quasistationary processes in, longitudinal, 18: 20702
ion acceleration in, negative, 18: 20692
negative hydrogen ion decay in isochronous, on the basis of Lorentz force, 18: 20698
radiation effects on interior targets in, 18: 20687
remodeling of Washington University fixed-frequency, for isochronous operation, 18: 21157(R) (AFOSR-5284)
CYLINDERS
analysis of thin, clamped along oblique contour, 18: 21733(T) (ORNL-tr-19)
dissolution in potential gradient, current density and flow in electrolytic, 18: 20000
flow stability between rotating, effects of axial magnetic field on Couette, 18: 20191
heat transfer from hollow, to circulating fluid, 18: 20184
CYSTEINE
effects on oxygen balance in bone marrow and brain of rabbits, 18: 19801
effects on radiosensitivity of cow achilles tendon, 18: 19629
protective effects in Serratia against x radiation, 18: 19785
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
CYTIDINE
desoxy-, radiation effect on urinary excretion by rats, 18: 19684
radiation effects on HeLa cell RNA uptake of tritiated, x, 18: 19599
CYTOLOGY
carcinogenic effects of somatic mutations in cells, 18: 19505 (BNL-7912)
cell generation cycle in neoplastic cells, 18: 21701 (BNL-7925)
chemical toxicity in human, effects on antibody production, 18: 19523
proliferation of bone marrow cells, 18: 19509
radiation effects on human marrow, gamma and neutron, 18: 19602
radiation effects on Stenobothrus germ cell, x, 18: 19615
radiation effects on HeLa cell, x, 18: 19723
CYTOPLASM
particles in mouse tumor, 18: 21732(T) (ANL-Trans-7)
radiation effects on lysosomes in rat liver cell, from plutonium-239, 18: 19669

D

DATA RECORDING SYSTEMS
evaluation of, for use with radiation-scanning systems, 18: 19835
DATA TABULATIONS
angular momentum weight factors, 18: 21212 (PAN-445/VI)
cross sections and group constants for reactor shielding calculations, 18: 21545 (HW-73381(Suppl.1))
excited states of even-even nuclei, 18: 21303
gamma production cross sections, 18: 21169 (GEMP-278)
meteorological observations at Ouejuyo up to 30,000 m, 18: 20814
neutron cross sections for tantalum, nine-group, 18: 21170 (GEMP-279)
physical properties of liquid metals, 18: 20516 (EUR-599.d)
x-ray scattering parameters, 18: 20809
DECANE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
DECAY SCHEMES
analysis of, for short-lived nuclear isomeric states, 18: 21249
DECONTAMINATION
equipment for, at Kernforschungszentrum, Karlsruhe, 18: 21692
of Vistula River water by Warsaw filtration plant, 18: 20229 (CLOR-23)
DEHYDROGENASES
radiation effects on activity of lactic acid, in rats, 18: 19705
DENSITOMETERS
design of radiometric, for liquids, 18: 20320

properties of radiometric, in industry, 18: 20425
use of cobalt-60 gamma, in void fraction measurements in cavitating mercury, 18: 20167 (NP-13812)
DETONATION WAVES
atmospheric, from U.S.S.R. 1962 nuclear tests, 18: 21072
stability in ideal-gas medium, 18: 20648
DEUTERIUM
crystal structure of solid, temperature effects on, 18: 20008
determination of body water metabolism and turnover in dogs using, 18: 19530
deuteron reactions (d,n) at 3 to 19 Mev, cross sections for, 18: 21218
diffusion coefficients in carbon tetrafluoride, 18: 19963
dispersion in diffusion systems, quantum effects in, 18: 19961
effects on root development in corn and pea seedlings, 18: 19662
exchange in leucine-pyridoxal system, 18: 20027
microwave reactions in, electron ionization frequency for, 18: 21510
plasma of, stability of a-c positive column of, 18: 21412
spectra in mixtures with air and hydrogen, negative ions in afterglow, 18: 21093
viscosity of molecular, at 20 and 30°C, 18: 19989
DEUTERIUM IONS
acceleration of negative, in cyclotrons, 18: 20692
DEUTERIUM SYSTEMS
D–H, viscosity at 20 and 30°C, 18: 19989
D–T, shock waves from impact of accelerated solid particles in, attainability of fusion temperatures in, 18: 21418
DEUTERONS
angular distributions from (p,d) reactions, energy level spin effects on 18: 21299
attenuation by silicon semiconductor detectors, 18: 20376
effects on human kidney cells, methods for modification of, 18: 19760
interactions with electrons, nucleon structure studies from inelastic, 18: 20945
interactions with protons, proton polarization in elastic, 18: 21008
interactions with mesons (K^-), Y_1^0 resonance in, 18: 21020
interactions with protons, use of on-line computer for simulation in, 18: 21158 (BNL-7836)
interactions with protons, singularity in, 18: 20903 (JINR-E-1581)
interactions with mesons (K^-) at 100 to 150 Mev/c, effects of final-state interactions on cross sections for, 18: 20926
interactions with nucleons in three-body potential problem, integral equation for amplitude for, 18: 20930
quadrupole relaxation in heavy water and perdeuterobenzene, measurement of, 18: 19962
reactions (d,α) with aluminum-27, beryllium-9, fluorine-19, nitrogen-14, phosphorus-31, and vanadium-51, differential cross sections for, 18: 21157(R) (AFOSR-5284)
reactions (d,He^6) with nuclei, analysis of, 18: 21204 (LADC-6302)
reactions (d,He-3) with sulfur-32 at 12.8 Mev, 18: 21210 (PAN-288)
reactions (d,nγ) with boron-11 at 15.1 Mev, resonances in, 18: 21336
reactions (d,n) with nuclei, spin-orbit interactions in, 18: 21366
reactions (d,n) with deuterium and tritium at 3 to 19 Mev, cross sections for, 18: 21218
reactions (d,n) with fluorine-19 at 2.5 to 3.3 Mev, angular distributions from, 18: 21241
reactions (d,p) and (d,2n) with tungsten-184, total cross sections for, 18: 21335
reactions (d,p) with yttrium-89 at 5 to 12 Mev, isomer production in, 18: 21279
reactions (d,p) with tungsten-186, total cross sections for, 18: 21335
reactions (d,t) at 14.7 Mev, spin dependence of angular distributions from, 18: 21301
scattering by cadmium-114 and nickel-60, elastic, 18: 21161 (CONF-417-26)
scattering by copper, iron-54, and nickel at 7 to 12 Mev, angular distributions from elastic, 18: 21292
DIABETES
radiation effects on hamster, x, 18: 19672
DIAMONDS
electron excitation in, by alpha and beta particles, 18: 20746
DIAPHRAGMS
development of iron–tantalum, for regenerative cells, 18: 20450(R) (BMI-1661(Del.))
DIAZONIUM GROUP
benzene, thermal decomposition in aqueous acid solutions containing strong nucleophile, 18: 19837(R) (MIT-905-1)
DIBENZOFURAN
alpha and electron excitation of, pulse-height ratios for, 18: 20408
DIELECTRIC BREAKDOWN
anode vaporization in vacuum, 18: 20142
cathode and humidity effects on uniform field, in air, 18: 20602
development stages in air, 18: 20146
electrode surface effects on, in plane and plane-point geometries, 18: 20141
in gases at optical frequencies, mechanisms for, 18: 21513
in parallel plate geometries, model for, 18: 21492
in plane-point electrode geometries, relation to impulse corona, 18: 21489
in plasma theta-pinch device, 18: 21525
production in crossed fields at low pressure, 18: 20153
production in plane-sphere gaps by pulsed voltages, 18: 20150
properties in plane-sphere electrode geometry in vacuum, 18: 20138
properties in plane-point and plane-wire gaps, 18: 20148
properties in theta pinch, 18: 21530
radiation effects on uniform field, in air, 18: 20602
theory of d-c, in vacuum, 18: 20140
theory of vacuum, 18: 20139
DIELECTRICS
failure mechanisms of ceramic, 18: 20526(R) (RADC-TDR-63-269)
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
DIES
design of two-stage split and shear, 18: 20134(R) (ORNL-TM-792)
DIET
analysis for fission products from fallout in Japan, 1962 and 1963, 18: 20232 (JAERI-1057)
strontium content of, 1953 through 1961, 18: 20235 (NP-13868)
strontium-90 uptake by mammalian skeletons as affected by, 18: 19533
DIFFERENTIAL EQUATIONS
solutions of nonlinear hyperbolic partial, 18: 20441
DIFFERENTIAL THERMAL ANALYSIS
developments in, review of, 18: 19864
DIFFRACTION
approximation method for, 18: 20657
DIFFUSION
book: *Solid State Diffusion in Metals and Alloys*, 18: 20536(T) (AEC-tr-6313)
of gases in natural rubber and polyethylene films, quantum isotope effects in, 18: 19961
of particles, use of Poisson collections in calculation of, 18: 20442
DIMETHYLAMINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
DIODES
development of cesium, 18: 21367(R) (AD-429133)
performance of thermionic, using inert gases, 18: 20831 (APL-TDR-64-28)
performance of tunnel, for detection of pulse pile-ups, 18: 20296
plasma, oscillations in, 18: 20840
theory of isothermal, current-voltage data in, 18: 20844
DIOXANE
dioxane–H_2O, electric conductivity of lithium-7-labeled lithium chloride in, 18: 19976
use in tritium detector, 18: 19887
dioxane–H_2O, dielectric properties of, 18: 19957
dioxane–D_2O, dielectric properties of, 18: 19957
DISASTERS
radiological emergency procedures for laymen, 18: 20273
DISCONNECTS
testing pressurized helium loop, 18: 21681 (HW-80680)
DISEASES
radiation effects on rabbit immune reactions to smallpox, x, 18: 19737
radiation effects on immunity to virus, review, 18: 19747
radiotherapy for mycosis, using linear accelerator electrons, 18: 19820

DISPERSE SYSTEMS
diffusion of gases in, quantum isotope effects in, 18: 19961
DISSOCIATION
molecular, electron affinities deduced from, 18: 19993
DISSOLVERS
current density and flow in electrolytic, 18: 20000
design and performance for fuel elements, 18: 20115
DISTILLATION APPARATUS
development for organic reactor coolants, 18: 21552 (NAA-SR-Memo-7545)
DOGS
lymph system irradiation using yttrium-90-labeled DTPA, 18: 19601
metabolism and turnover of body water in, using deuterium, 18: 19530
radiation effects on blood enzymes of, 18: 19683
radiation effects on leukocytes of, 50- *vs.* 250-kvp x, 18: 19585
radiation effects on, 18: 19603
radiation effects on skin homografts in, whole-body, from bismuth-206 and silver-111, 18: 19605
radiation effects on nervous activity in antenatally irradiated, x, 18: 19608(T)
radiation effects on blood loss in, 18: 19732
radiation effects on hemopoiesis in, with decortication, 18: 19733
radiation effects on, protective effects of bone marrow transplants against, 18: 19764
radiation effects on, protective effects of bone marrow against, gamma, 18: 19769
radiation effects on, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and *p*-aminopropiophenone against, x, 18: 19794
radiation effects on, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and *p*-aminopropiophenone against, x, 18: 19795
radioinduced hemorrhagic diathesis in, beta, 18: 19600
DOUNREAY FAST REACTOR
coolant analysis and chemistry in, effects of oxide impurities on, 18: 21661
coolant purification by cold trapping, 18: 21657
DRILLS
development of pneumatic deep-hole, 18: 20134(R) (ORNL-TM-792)
DROSOPHILA
genetic evolution in populations of, 18: 19506(R) (TID-20401)
radiation effects on life span of, 18: 19554 (TID-20550)
radiation effects on spermatozoa genetic response in, neutron and x, 18: 19647
radiation effects on fertility and mortality of, x, 18: 19750
radioinduced dominant lethality in oocytes of, factors affecting, 18: 19622
radioinduced mosaics in, x, 18: 19618
radioinduced mutation in, dose-rate effects on, 18: 19646
radiosensitivity of, effects of cold treatment after irradiation on, 18: 19707
DRUGS
properties as radiosensitivity index, 18: 19680
DUST HAZARDS
prevention in nuclear materials mines, 18: 20270
DYSPROSIUM
content and relative abundances in terrestrial materials, 18: 20202
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
luminescence of, method for determining L x-ray, 18: 21320
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from yttrium by countercurrent electrolytic methods, mass effects in, 18: 20112
DYSPROSIUM ISOTOPES Dy-155
electron conversion spectra, 18: 21175 (JINR-P-1479(p.26-34))
positron decay spectra, 18: 21176 (JINR-P-1479(p.35-9))
DYSPROSIUM ISOTOPES Dy-158
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
DYSPROSIUM ISOTOPES Dy-160
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
DYSPROSIUM ISOTOPES Dy-161
Mössbauer effect in, effects of high pressures on, 18: 21214 (UCRL-10630(Rev.))
nuclear quadrupole moments, 18: 21214 (UCRL-10630(Rev.))
DYSPROSIUM ISOTOPES Dy-162
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
DYSPROSIUM ISOTOPES Dy-164
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
DYSPROSIUM ISOTOPES Dy-165
conversion electron spectra of isomer of, 18: 21320

E

EARTH
current of, high-altitude nuclear test effects on, 18: 21085
electric current generated by magnetic field of, 18: 21083
explosions in alluvium, granite, rock salt, and tuff, cavity and chimney formation in, 18: 20122 (UCRL-7711)
seismic wave propagation along surface of, from high-altitude explosions, 18: 21081
thermal history, nonuniform energy distribution in, 18: 21074
ECOLOGY
radioactivity of vertebrates, effects of environment on, 18: 19517
EGGS
radiation and temperature effects on hatching and pathogenicity of *M. hapla*, ultraviolet, 18: 19759
ELASTICITY
modulus measurement at high temperatures, ultrasonic technique for, 18: 20196 (UCRL-7326)
ELECTRIC ARCS
behavior of dynamic, in flowing environment, 18: 20129 (ARL-64-29)
behavior of three-phase, 18: 20129 (ARL-64-29)
cathode emission processes in vacuum, 18: 20143
cathode mechanisms, minimum burning voltages, and stability of vacuum, 18: 20631(R) (SC-DC-64-420)
electron emission from cathode of, mechanism for, 18: 20144
extinction time of overvolted vacuum, between aluminum, copper, titanium, and tungsten electrodes, 18: 20631(R) (SC-DC-64-420)
performance of d-c, with transpiration-cooled walls, 18: 21374 (GNE/PHYS/63-2)
plasma production in arc heaters, effects of vortex flow on, 18: 21393
production in vacuum, 18: 20142
properties of whirl-stabilized, in d-c plasmatrons, 18: 20662
space charge sheaths in, 18: 21373 (EUR-495.i)
ELECTRIC CONDENSERS
radiation effects on, transient, 18: 20321
ELECTRIC CONDUCTIVITY
in rat stomach, mechanisms for, 18: 19521 (USNRDL-TR-716)
measurement in magnetohydrodynamic cells, design and operation of double Langmuir probe for, 18: 20830(R) (AD-432464)
ELECTRIC CONTROL SYSTEMS
design for regulation of bubble-chamber temperature, 18: 20367
ELECTRIC CURRENTS
generation by geomagnetic field, 18: 21083
intensity in discharge between plane-point electrode geometries, 18: 21482
radioinduced in teflon, gamma, 18: 20592
ELECTRIC DISCHARGE
cathode electron emission in helium, 18: 21452
cathode performance in neon glow, effect of active gas additives on, 18: 21456
cathode secondary emission in, 18: 20136
electric current intensity of, in plane-point electrode geometries, 18: 21482
electric impedance characteristics of argon, 18: 21457
electric impedance of argon, measurement of, 18: 21459
electron avalanches in, mechanisms of, 18: 21491
electron avalanches in, space charge effects on, 18: 21490
equipment for, development of trigatrons for, 18: 20147
equipment for, properties of trigatrons in, 18: 20151
gas temperatures in, interferometric determination of, 18: 21481
helium ionization in, coefficient for, 18: 21472
hydrogen dissociation in, 18: 21466

hydrogen ion production in, in crossed fields, 18: 20155
hydrogen spectral line intensity in Townsend, 18: 21473
in pressurized spark gap, formative time lags in, 18: 21493
ion motion in, forward and retrograde, 18: 20144
ion motion in, in transverse magnetic fields, 18: 21488
ion production in Penning, as source, 18: 20154
ion yields in carbon dioxide glow, 18: 21455
ionization coefficients for, 18: 21477
ionization in, mass effects on secondary, 18: 20137
ionization striations in positive column of, properties of, 18: 21478
kinetics of low-pressure, model for, 18: 21467
mercury ionization phenomena in, 18: 21476
oscillations in, in low-pressure rare gases, 18: 21479
photon absorption in gas, coefficient for, 18: 21474
plasma atom and electron densities in r-f, measurement of, 18: 21512
plasma constriction in glow, mechanisms of, 18: 21462
plasma constriction by electric fields in glow, 18: 21463
plasma dipolar resonance effects in h-f, 18: 21515
plasma electric vs magnetic field hysteresis in, 18: 21403
plasma helical structure in r-f, 18: 21516
plasma in helium hollow-cathode, properties of weakly ionized, 18: 21375 (MATT-236)
plasma ohmic heating in transient, 18: 21522
plasma oscillations in d-c, 18: 21460
plasma oscillational interactions with Penning gage conduction mechanism in, 18: 21507
plasma production in, fully ionized, 18: 21496
plasma resonance radiation reflection by walls of, 18: 21464
plasma rotation in, in crossed fields, 18: 21501
plasma stability in reflex, 18: 21503
production and decay times of diffusion-controlled electrodeless, 18: 21509
production in undervolted gaps by fast electron pulses, 18: 20149
production of disruptive, mechanisms for, 18: 21494
propagation in rarefied gases, 18: 21511
properties of helium, under pressure, 18: 20640
properties of non-controlled h-f, review of, 18: 21508
properties of prebreakdown, in plane-point electrode geometries, 18: 20145
properties of r-f, in single-turn coil geometry, 18: 21514
properties of stabilized, in argon, 18: 21498
radioinduced on polymers, 18: 20068
resonance depression in high-frequency, 18: 20663
spectra of toriodal, in weak magnetic field, line variations in, 18: 21435
spectra of x rays from anode of Penning, 18: 21502
stabilization of, mechanisms of vortex, 18: 21495
striations in neon, 18: 21451
theory of glow, 18: 21454
theory of high-pressure and high-voltage, 18: 21480
theory of self-quenching, 18: 21475
yields from d-c, in nitrogen vapor systems, 18: 20013

ELECTRIC FIELDS
effects on radiolysis of carbon monoxide, 18: 20087
effects on spin orientation of spin-½ particles with pseudoscalar charge density, 18: 20946
electric breakdown in crossed magnetic and, 18: 20153
electric discharge in crossed magnetic and, plasma rotation in, 18: 21501
interactions with ions, power generation by, 18: 20833 (GA/PHYS/63-11, 12)
plasma constriction by a-c and d-c, in glow discharges, 18: 21463
plasma containment in h-f, 18: 21518
plasma discharge in, hysteresis in, 18: 21403
plasma electric conductivity in h-f, 18: 21401
plasma stability in crossed magnetic and, 18: 21505
properties of quasi-potentials from h-f, in plasma, 18: 21519

ELECTRIC GENERATORS
performance of electrohydrodynamic, with alternating input, 18: 20833 (GA/PHYS/63-11, 12)

ELECTRIC INSULATORS
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)

ELECTRIC MOMENTS
dipole, dissipation in 2-level systems, 18: 21046

ELECTRIC POWER
generation by ion interaction with electric fields, direct, 18: 20833 (GA/PHYS/63-11, 12)
generation of, economic and technical risks in, 18: 21545

ELECTRIC PROBES
design and operation of double Langmuir, for magnetohydrodynamic cell diagnostics, 18: 20830(R) (AD-432464)
development and testing of capacitance temperature sensors, 18: 21564(R) (GEMP-81)
properties of, in cesium and mercury plasmas, 18: 21438

ELECTROCHEMISTRY
dissolutions in potential gradients, 18: 20000

ELECTRODES
electric breakdown and impulse corona in plane-point geometries of, relation between, 18: 21489
electric breakdown in parallel plate geometries of, model for, 18: 21492
electric breakdown between, in vacuum, 18: 20140
electric breakdown in plane-point geometries of, stages of, 18: 20146
electric breakdown in plane-point and plane-wire gaps of, 18: 20148
electric breakdown in plane-sphere gaps of, by pulsed voltages, 18: 20150
electric breakdown in coaxial cylinders of, in crossed fields, 18: 20153
electric current-voltage relation for rotating-disk, 18: 19936 (TID-20485)
electric discharge between plane-point geometries of, current intensity in 18: 21482
electric discharge in vacuum, mechanisms of, 18: 20142
electric discharge in plane-point geometries of, properties of prebreakdown, 18: 20145
electron emission from semiconducting, 18: 20152
ion bombardment of, charged-particle emission in, 18: 20665
potential measurements of silver single-crystal, 18: 19837(R) (MIT-905-1)

ELECTROLYSIS
measurement of transference numbers in, by moving-boundary method using radioisotopes, 18: 20010

ELECTROLYTES
measurement of transference numbers in, by moving-boundary method using radioisotopes, 18: 20010

ELECTROLYTIC CELLS
design and operation for studying electrode behavior, 18: 20287(T,R) (EURAEC-961(Pt.2))
electrode current-potential relations in, rotating-disk, 18: 19936 (TID-20485)

ELECTROLYTIC SEPARATION PROCESSES
mass effects on ion migration in countercurrent, 18: 20112

ELECTROMAGNETIC FIELDS
charged particle motion in, at cyclotron resonance, 18: 21383 (NP-13852)
charged-particle motion in inhomogeneous, approximate relativistic equations for, 18: 20646
performance for charged-particle-beam separations, 18: 20925
plasma acceleration by, 18: 21442
plasma particle orbits in r-f, 18: 21521
vector gauge fields, relation to non-Abelian, 18: 21060
Yang-Mills fields and magnetic monopoles, 18: 21062

ELECTROMAGNETIC LENSES
description of achromatic quadrupole, 18: 20686
design for meson beam formation, 18: 20703
focusing properties of wide-angle, apparatus for measuring, 18: 21022(P)

ELECTROMAGNETIC PUMPS
development for high-temperature liquid metals, 18: 20131 (NAA-SR-Memo-2368(Rev.))

ELECTROMAGNETIC SEPARATION
development for osmium isotopes, 18: 20432

ELECTROMAGNETIC WAVES
attenuation in spiral waveguide, 18: 20315
emission of v-l-f atmospheric, 18: 21088
instabilities in electron streams and plasmas in finite magnetic field, 18: 21446
nuclear explosion effects on v-l-f, 18: 21085
pathological effects of, on rabbit eyes, 18: 19547(R) (AMRL-TDR-63-71)

propagation in air, electron radiation effects on, 18: 20618(R) (NP-13799)
propagation in cold collisionless plasma, characteristics of, 18: 21381 (NASA-TN-D-2071)
propagation in cold collisionless plasma, frequency limits to, 18: 21382 (NASA-TN-D-2273)
propagation in waveguides, analysis of, 18: 20623 (JINR-P-1565)
propagation of transverse circularly polarized, in metal plasma, 18: 21047
reactions with powders, plasma production in, 18: 21524
reflection at ionospheric plasma, 18: 21441
resonant frequencies in cavity, 18: 20652
scattering by plasma, analysis of, 18: 21540
scattering by thermal nonequilibrium plasma, cross sections and number density fluctuations for, 18: 21420
theory of, bibliography on, 18: 21353

ELECTROMAGNETISM
conservation laws in, new, 18: 21033
effects in particle resonances, 18: 20999

ELECTRON BEAMS
desorption of carbon monoxide and oxygen from molybdenum by, at 0 to 300 ev, 18: 20641
focusing in symmetric growing magnetic fields, vertical, 18: 20704
injection into betatrons, processes governing, 18: 20689
interactions in plasma, hose instability in, 18: 21541
interactions with plasma, cathode space charge in, 18: 21453
phase shifting by magnetic fields, interferometric study of, 18: 20318
reactions with alkali halide crystals, dose distribution from, 18: 20043
use in nuclear technology for melting and welding, 18: 20491

ELECTRON CAPTURE
review of, from various electron shells, 18: 21228

ELECTRON MICROSCOPES
sample carrier design for, 18: 20319

ELECTRON MICROSCOPY
methods for dislocation loop analysis in crystals, 18: 20546
use in study of lattice planes and constants in single crystals, 18: 20319

ELECTRON PAIRS
bound state of, in quasipotential method, 18: 20909 (JINR-P-1572)
production in chlorine-35 (n,γ) reactions, angular distributions in, 18: 21236
production in electron reactions with aluminum, 18: 21311
production in electron reactions in lead, energy losses from, 18: 21334
production in relativistic electron reactions in media, 18: 20984

ELECTRON SHOWERS
number distribution of electrons in, expressions for moments of, 18: 20978
production in lead, bubble chamber measurements of, 18: 20669
production in lead, Monte Carlo calculations of, 18: 21322

ELECTRON TUBES
residual gases in, conference on, 18: 20305

ELECTRONIC EQUIPMENT
description of encoder for neutron time-of-flight studies, 18: 20363
design of binary-decimal and octal-decimal converter, 18: 20301
design of square-wave generator for use up to 250 Mc, 18: 20303
radiation effects on components of, gamma, 18: 20590
radiation effects on, transient, 18: 20321
radiation effects on design for space vehicles, 18: 20304
response of, binary cross-correlation measurement of impulse, 18: 20278 (AEEW-R-329)

ELECTRONS
attachment coefficients in plasma, measurement of, 18: 21470
attenuation by silicon semiconductor detectors, 18: 20376
avalanche development in electric discharge, space charge effects on, 18: 21490
avalanche development in electric discharge, mechanisms of, 18: 21491
binding energies in atoms, photoelectron method of determining, 18: 20766
bremsstrahlung emission by 32-Mev, angular distributions and polarization in, 18: 21013
chemical effects on amino acids, 18: 20074
chemical effects on vitamin B_{12}, 18: 20090
chemical effects on aromatics, production of free radicals in, 18: 20042 (USNRDL-TR-718)
chemical effects on water, 18: 20050
chemical effects on deaerated aqueous solutions of nitrous oxide-containing 2-propanol, 18: 20058
chemical effects on polyisobutene, yields of fractures, double bonds, and and gas in, 18: 20064
chemical effects on α-methylstyrene, 18: 20070
density and energy distributions in Z pinch, 18: 21532
density and temperature in theta-pinch discharge, 18: 21526
density distributions in low-temperature discharges, 18: 21465
density distributions in theta pinch, 18: 21529
density in lower ionosphere, 18: 21075
density in plasma, method for measuring, 18: 21384 (NP-13853)
density in plasma, interferometric measurement of, 18: 21512
detection and measurement of, ionization chamber for, 18: 20394
detection and measurement using silver halide nuclear emulsions, 18: 20414
diffusion across magnetic field in plasma, 18: 21426
diffusion of plasma, across magnetic field, 18: 21388 (TID-20491)
distribution in plasma in external homogeneous magnetic field, kinetic instability of, 18: 21432
dosimetry of fast, development of methods for, 18: 19811
effects of pulsed, on germanium, 18: 20583 (PAN-473/II)
effects on beryllium oxide crystals at 1 Mev, 18: 20604
effects on electromagnetic wave propagation in air, 18: 20618(R) (NP-13799)
effects on silicon surface-barrier detectors, 18: 20357
effects on tensile strength of cow achilles tendon, effects of cysteine, drying, hydration, and tanning on, 18: 19629
ejection from argon and neon, atom readjustment to, 18: 20729 (CONF-481-6)
ejection from tungsten surface by helium, hydrogen, nitrogen, and oxygen, energy distributions and yields in, 18: 20777
emission by cathodes in vacuum, mechanisms of, 18: 20139
emission by discharge tube cathodes, 18: 21452
emission by tungsten cathodes, properties of thermal, 18: 20842
emission from arc cathodes, mechanism for, 18: 20144
emission from semiconducting electrodes, 18: 20152
emission in anion-atom reactions, energy spectra of, 18: 20771
emission in ion reactions with discharge tube cathodes, ionization from, 18: 20137
emission in thermionic cells, parameter for S-curves of, 18: 20866
energy in plasma in radially increasing magnetic field, increases in, 18: 21499
energy losses from ionization in nuclear emulsions, 18: 20391
field theory for, charge conservation in, 18: 21024
interactions with deuterons, nucleon structure studies from inelastic 18: 20945
interactions with positrons, cross sections for mesons (π^-) and (π^+) production in, 18: 20986
interactions with nucleons, quantum electrodynamics of, 18: 21014
interactions with phonons, field theory of, 18: 21066
interactions with photons in condensed media and plasma, "photon-drag" effect in, 18: 21407
interactions with photons in plasma, kinetic theory of, 18: 21411
interactions with valence electrons of core, contribution to hyperfine structure, 18: 20749
interactions with photons at 0.2 to 2 Mev, K-shell, 18: 20753
ionization by, threshold law for, 18: 20761
ionization frequency in deuterium, 18: 21510
ionization of cesium and hydrogen by, calculation of cross sections near threshold for, 18: 20779
ionospheric, energy sources for, 18: 21084
losses in discharge plasma, ambipolar diffusion and recombination, 18: 21433
magnetic shielding of, by neighboring atom, 18: 21232
many-body problem of, Heitler-London approach to, 18: 20747
molecular dissociation by, electron affinities from, 18: 19993
motion in plasma, 18: 21436
mycosis fungoides therapy using linear accelerator, 18: 19820
operator treatment of, in screening constant model of complex atoms,

18: 20731 (RM-3803-AEC)
polarization correlations in K-shell photoeffect at 0.2 to 2 Mev, 18: 20754
polarization of, method for measuring longitudinal, 18: 21339
potential of orbital, at nucleus, 18: 20744(T)
production in neutron capture by nuclei, 18: 20332 (KR-64(Sect.XII))
range-energy relation for, semi-empirical, 18: 20929
reactions in lead, bremsstrahlung and pair production in, 18: 21334
reactions in media, bremsstrahlung and pair production in relativistic, 18: 20984
reactions in undervolted spark gaps, discharge triggering in ionization, 18: 20149
reactions with aluminum, electron pair production in, 18: 21311
reactions with atoms and ions, ionization cross sections for, 18: 20768
reactions with cesium atoms, cross section measurement by microwave spectrometry, 18: 21379(R) (N63-13602)
reactions with cesium at low energies, cross sections for, 18: 20773
reactions with helium, excitation cross section for, 18: 21471
reactions with helium, absolute excitation cross sections for, 18: 20752
reactions with Penning-discharge anodes, x-ray spectra from, 18: 21502
reactions with scintillators, pulse-height ratios for comparison with alpha particles, 18: 20408
runaway in toroidal discharges, 18: 21533
scattering as function of energy and angle, back-, 18: 20943
scattering by gases at 40 to 130 kev, linear displacement distributions in multiple, 18: 21316
scattering by helium and hydrogen atoms, wave functions for, 18: 20735
scattering by hydrogen molecular ion, inelastic, 18: 20750
scattering by nuclei, nucleon pair-correlation functions from inelastic, 18: 21356
scattering by nuclei at high energies, energy losses in, 18: 21302
scattering by polyatomic molecules, vibronic interactions in excitation cross sections for, 18: 20760
scattering by rare gases at 25 kev, cross sections for and optical transitions in, 18: 20764
scattering by thin foils, 18: 20670
scattering in thermionic diode unignited mode, 18: 20846
scattering in thermionic diode unignited mode, 18: 20847
scattering of polarized, by oriented nuclei, 18: 21181 (JINR-P-1575)
slowing down spectrum in copper, from copper-64, 18: 20732 (TID-20561)
structure in cerium, gadolinium, and ytterbium from positron annihilation measurements, 18: 20552
synchrotron radiation from, in earth's magnetic field and from high-altitude nuclear explosion, 18: 21086
synchrotron radiation by, in magnetic field of M82 galaxy, 18: 20718
temperature distributions in plasma in magnetic field, 18: 21468
temperature effects in plasma in strong electric field, 18: 21447
temperatures in Stellarators (C), measurement of, 18: 21378 (MATT-251)
temperatures in thermal plasma column, 18: 21469
transport in plasma, 18: 21439

ELECTROPHORESIS
methods in thin-layer, 18: 19854(T) (SC-T-64-49)
use of thin-layer, in separation of phenols and phenolic acids, 18: 21736(T) (SC-T-64-615)

ELECTROSTATIC FIELDS
effects on boiling, 18: 20174 (TID-7694(p.37-41))

ELECTROSTATIC LENSES
focusing properties of wide-angle, apparatus for measuring, 18: 21022(P)

ELECTROSTATIC SEPARATION
limitations of multiplate, 18: 20680 (NIRL/R/49)

ELEMENTARY PARTICLES
antineutrinos and neutrinos as different states of same particle, feasibility of, 18: 20919
classification of, algebra of charge properties for, 18: 20981
classification schemes for, 18: 20898 (CERN-64-6(p.49-70))
conference on, 18: 20993
Feynman rules for arbitrary-spin massless, in relativistic field theory, 18: 20944
field theoretical mixing of, in pole approximation, 18: 20947
field theory for, spinors in, 18: 21024
interaction amplitudes for, asymptotic relations between, 18: 20907 (JINR-P-1564)
interaction potentials of, exactly soluble 1-dimensional N-body, 18: 20923
interactions and theory, 18: 21712(R) (NYO-10065)
interactions at cosmic energies, detector array for studying, 18: 20325(R) (AROD-2427:1)
interactions at low energies, nonadiabatic transitions in, 18: 20985
interactions at very high energies, nuclear emulsion studies of, 18: 20901 (CERN-64-6(p.125-42))
interactions in systems of, Green function and mass operator for, 18: 20987
interactions of strongly interacting, at high energies, 18: 20971
interactions of, anomalous singularities and amplitudes for, 18: 20903 (JINR-E-1581)
interactions of, cosmic-ray studies of strong, 18: 20968
interactions of, measurement of elastic, 18: 20897 (CERN-64-6(p.31-48))
interactions of, maximal second-degree analyticity of s-matrix for strong, 18: 20917 (UCRL-10786)
interactions of, matrix elements of, octet operator of SU, for, 18: 20922
interactions of, overlapping in three-particle resonant final-state, 18: 21044
interactions of, Regge trajectories in Bethe-Salpeter equations for, 18: 20989
interactions of, single-particle exchange model for, 18: 21000
interactions of, three simultaneous two-body final-state, 18: 20916 (UCRL-10773)
interactions with bound particles, resonances in, 18: 20906 (JINR-P-1562)
invariant variables for n particles and phase-space volume element, 18: 21305
parity conservation and unitary symmetry, 18: 20955
polarization of, covariant description of, 18: 20893 (AFOSR-5287)
potential equation for two-body systems, renormalized quasi-, 18: 20908 (JINR-P-1566)
production of, angular momentum factors for multiple, 18: 21212 (PAN-445/VI)
production of, fib theory of, 18: 20719
production of, with charge ⅔ e, 18: 20952
research at CERN of, review, 18: 20400
resonances of, G-parity and electromagnetic effects in, 18: 20999
resonances of, observations of, 18: 20899 (CERN-64-6(p.71-98))
review, 18: 20972
scattering by nuclei at high energies, differential cross sections for, 18: 21333
spin projection operators for vector, 18: 20979
theory of, review, 18: 20970
theory of, review of, 18: 20910 (NP-13837)

ELK RIVER POWER REACTOR
pressure vessel serviceability, evaluation of, 18: 20528(R) (SWRI-1228-18)
pressure vessel serviceability, 18: 20457(R) (SWRI-1228-19)

EMBRYONIC TISSUES
radiation effects on amphibian gastrula, x, 18: 19649

EMBRYOS
radiation effects of fractionated x-ray doses on development of mouse, 18: 19719
radiation effects on amphibian gastrula, x, 18: 19649
radiation effects on morphogenesis of tibiotarsus in chick, 18: 19657
radiosensitive sites in Tribolium, use of linear accelerators for finding, 18: 19668

EMISSIVITY
measurement for refractory oxide coating, hot-filament method for, 18: 20565
measurement to 3000°K, equipment for, 18: 20567
measurements at 800 to 5000°K, relation of structure to, 18: 20566

ENDOCRINE GLANDS
radiation effects on rat suprarenal, x, 18: 19676

ENGINEERING TEST REACTOR
reactivity prediction as function of power-time in, 18: 21685

ENZYMES
heavy-ion effects on activity of, 18: 19571

radiation effects on guinea pig lung, x, 18: 19675
radiation effects on, in dog blood, 18: 19683
radiation effects on activity of Rhodotorula, protective effects of cystamine against, beta, 18: 19786
radioinduced Neurospora mutant lacking ornithine transcarbamylase, uv, 18: 19621
EPITHELIUM
radiation effects on corneal and intestinal, in mice, 18: 19689
EQUIPMENT AND PROCEDURES
development in support of laboratory programs, summary, 18: 21715(R) (ORNL-TM-791)
digital printout system for whole-body scanner, 18: 20346
for bone marrow cell separation, 18: 19525
index of reports on developments in engineering, fabrication, and field support of laboratory programs, 18: 21716(R) (ORNL-TM-794)
ERBIUM
content and relative abundances in terrestrial materials, 18: 20202
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
ERBIUM ALLOYS
Er–Fe, erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
Er–Mn–Fe, erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
ERBIUM ISOTOPES Er-164
energy levels, 18: 21174 (JINR-P-1479(p.3-25))
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
ERBIUM ISOTOPES Er-166
energy level at 81 kev, hyperfine structure of $(2^+ \rightarrow 0^+)$ transition of, 18: 21272
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
nuclear hyperfine structure in, Mössbauer study of, 18: 21272
ERBIUM ISOTOPES Er-168
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
ERBIUM ISOTOPES Er-170
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
ERBIUM OXIDES
erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
ERYTHROCYTES
effects of ozone on x-irradiated human, mouse, rat, and rabbit, 18: 19538
proliferation kinetics and regulation, 18: 19504 (BNL-7839)
radiation and postirradiation bleeding on iron-59 uptake by, 18: 19717
radiation effects on mouse immunity to sheep, continuous gamma, 18: 19623
radiotoxins released by, 18: 19653
ERYTHROPOIESIS
kinetics and regulation of, 18: 19504 (BNL-7839)
radiation effects on erythropoiesis in, gamma, 18: 19611(T)
radiation effects on, in whole-body irradiation of patients with dermatologic diseases with ultraviolet or x radiation, 18: 19712
radioinduced in rats, gamma, 18: 19593
ERYTHROPOIETIN
effects on radiosensitivity of stem cells in mice, 18: 19635
ESCHERICHIA COLI
radiation effects on DNA degradation in, x, 18: 19641
radiation effects on, effects of medium on, 18: 19681
radiation effects on radiosensitivity, 18: 19686
radiation effects on genetic recombination in, after female irradiation, 18: 19620
radioinduced phages in, x, 18: 19739
radioresistance in, gene locus for, 18: 19619
ESTERASES
radiation effects on activity of E-600-resistant and nonspecific, in adrenal glands of guinea pigs, 18: 19710
ETHANE
production by pyrolysis of ethyl iodide in toluene, 18: 20023 (TID-20510)
reactions with carbon atoms, mechanism of ethylene and propene formation in, 18: 20022 (CONF-322-10)
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
ETHANE, BROMO-
production using gamma radiation, equipment and process development and operation for, 18: 20048
ETHANE, HEXAFLUORO-
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
ETHANE, IODO-
pyrolysis of, in toluene, 18: 20023 (TID-20510)
ETHANETHIOL, 2-AMINO-
effects on DNA synthesis in mice, 18: 19524
effects on oxygen balance in bone marrow and brain of rabbits, 18: 19801
protective effects against radiation in human kidney cells, 18: 19760
protective effects in mice against x radiation, 18: 19775
protective effects against x radiation in rat hair, 18: 19784
protective effects in rat mucosa against x irradiation, 18: 19787
protective effects in mice against x irradiation, 18: 19788
protective effects in rats against radiotherapy for Walker carcinomas, 18: 19798
radiosensitivity effects on *E. coli*, 18: 19681
ETHANOL
nuclear magnetic resonance of sorbed, on thorium oxide, temperature dependence of, 18: 20632 (TID-18689)
scintillation quenching in, gamma, 18: 20352
spectra of uranium tetrachloride in, absorption, 18: 19935 (TID-18814)
x-ray scattering cross sections, 18: 20035
ETHANOL, 2-AMINO-
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49))
ETHANOL, MERCAPTO-
protective effects in Serratia against x radiation, 18: 19785
ETHERS
benzyl phenyl, analysis for oxygen-18, mass spectrographic, 18: 19837(R) (MIT-905-1)
ETHYL ETHER
effects on iodine-131 secretion in thyroidectomized guinea pigs, 18: 19528
electric discharge in, electron avalanches in, 18: 21490
solvent properties for manganese and protactinium, 18: 20105
ETHYLAMINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
ETHYLAMINE, 2,2'-DITHIOBIS-
effects on urinary excretion of 5-hydroxyindoleacetic acid in irradiated rats, 18: 19639
protective effects against x radiation in rat hair, 18: 19784
protective effects in yeast enzymes against beta irradiation, 18: 19786
protective effects against radiation in white mice, mechanism of, 18: 19800
ETHYLENE
effects on hydrogen yields in radiolysis of hydrobromic acid-hydrochloric acid and hydrochloric acid, 18: 20062
electric discharge in, secondary ionization in, 18: 20137
formation by carbon atom reactions with ethane, mechanism of, 18: 20022 (CONF-322-10)
production by pyrolysis of ethyl iodide in toluene, 18: 20023 (TID-20510)
radioinduced polymerization with tetrafluoroethylene, 18: 20057
reactions with carbon atoms, mechanism of allene formation in, 18: 20022 (CONF-322-10)
ETHYLENE, CHLORO- POLYMERS
reactions with organotin compounds labeled with carbon-14 in alkyl group, stabilization, 18: 20028
reactions with organotin compounds labeled with tin-113, stabilization, 18: 20029
reactions with organotin compounds labeled with carbon-14, stabilization, 18: 20030
sorptive properties of Ensolite foam for tritium and tritiated water vapor, 18: 20458 (USNRDL-TR-717)
ETHYLENE GLYCOL
flow of, heat transfer in two-phase, 18: 20171 (TID-7694(p.18-23))
ETHYLENE POLYMERS
dispersion of gases in films of, quantum isotope effects in, 18: 19961
neutron attenuation by, from 14-Mev source, 18: 19821

neutron diffusion in, extrapolation lengths at different energies for, 18: 21132 (RPI-328-4)
radiation effects on properties of, 18: 20089
ETHYLENE, TETRAFLUORO-
radioinduced polymerization with ethylene, 18: 20067
ETHYLENE, TETRAFLUORO- POLYMERS
radioinduced electric currents in, 18: 20592
EUGLENA
photosynthetic activity during mitosis in, 18: 21721 (TID-18753)
EUROPE
accelerator developments in, 18: 20697
nuclear power development in, role of State in, 18: 21644(T) (AEC-tr-6385)
EUROPIUM
compressibility at room temperature, 18: 20553
content and relative abundances in terrestrial materials, 18: 20202
determination in thorium using xylenol orange, spectrophotometric, 18: 19883
determination in zinc solutions by chemical stripping, 18: 19851(R) (TID-20548)
performance as poison for ANP open-cycle reactor, 18: 21561 (APEX-603(Del.))
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
EUROPIUM ISOTOPES Eu-150
decay and half life, 18: 21348
EUROPIUM ISOTOPES Eu-152
beta decay of, circular polarization of gamma radiation following, 18: 21309
beta decay of, gamma spectra in, 18: 20386
EUROPIUM ISOTOPES Eu-153
energy levels from gadolinium-153 and samarium-153 decays, 18: 21271
EUROPIUM ISOTOPES Eu-154
beta decay of, gamma spectra in, 18: 20386
EUROPIUM ISOTOPES Eu-157
beta decay scheme, 18: 21234
EUROPIUM OXALATES
decomposition of, differential thermal and thermogravimetric analysis of, 18: 19897
preparation, 18: 19897
EUXENITES
curium-247 content in, 18: 20217
EVAPORATORS
performance for purification of radioactive wastes, 18: 21695
EXCRETORY SYSTEMS
radiotherapy of carcinoma of urinary bladder, 18: 19827
EXOSPHERE
hydromagnetic shock-wave propagation in, 18: 21077
hydromagnetic wave amplification in, 18: 21076
EXPERIMENTAL BOILING WATER REACTOR
heat transfer in two-phase flow in, 18: 20170 (TID-7694(p.11-17))
EXPERIMENTAL BREEDER REACTOR-II
design and modifications, 18: 21698(R) (ANL-6860)
structural support of, analysis of deformation of, 18: 21581
EXPERIMENTAL GAS COOLED REACTOR
fuel assembly fabrication, 18: 21653
EXPERIMENTAL ORGANIC COOLED REACTOR
fuel element fabrication for, extrusion of hexagonal APM alloy tubes for, 18: 21569 (NAA-SR-Memo-8121)
EXPLODING WIRE PHENOMENA
burst time of, upper bound for, 18: 20634 (UCRL-7177)
energy shunting mechanisms at reduced pressures, 18: 21536
vaporization in, conductor configuration effects on, 18: 21535
EXPLOSIONS
crater formation by high-explosive sources in desert alluvium, calculation, 18: 20123 (UCRL-7738)
EXPONENTIAL PILES
design and teaching applications, 18: 21689
reactivity measurements on, using pulsed-neutron sources and monoenergetic diffusion-transport theory, 18: 21607
EXTRACTION APPARATUS
design and development of centrifugal, for air-water and steam-water systems, 18: 20128(R) (ACNP-64021)
design of, for determining trace amounts of extractables from food-packaging materials, 18: 19889
EYES
radiation effects on mitosis of corneal epithelium in mice, 18: 19689
radiation effects on fibroblast proliferation and vascularization of cornea tissue, tracer studies of, 18: 19708
radiation effects on mouse, protective effects of 2-(2-aminoethyl)-2-thiopseudourea AET and bone marrow against, x, 18: 19796
radiodiagnosis of tumors of, 18: 19823
radioinduced chorioretinal burns of rabbit, 18: 19547(R) (AMRL-TDR-63-71)

F

FALLOUT
analysis for cesium-137 and strontium-90 by ion exchange, 18: 19880
contamination of municipal water facilities by nuclear attacks, 18: 20233 (NP-13806)
deposition during cyclonic storm, rate variations in, 18: 20215
determination in food and total diet by FDA, program for, 18: 20255
diffusion in nonuniform atmosphere, 18: 20620
distribution in atmosphere, 1962, 18: 21082
food crop contamination by, mathematical model for, 18: 19515 (NP-13796)
monitoring in air, fish, plants, soils, and waters in Switzerland, 1956 to 1961, 18: 20218
monitoring in England, 1961 and 1962, 18: 20208 (AERE-R-4415)
monitoring in environs of factories of photographic industry, 18: 20251
monitoring in Japan, 1962 and 1963, 18: 20232 (JAERI-1057)
monitoring in milk in German Federal Republic, Sept. 1961 to Sept. 1962, 18: 19809
monitoring in New Zealand, 1963, 18: 20234(R) (NP-13859)
monitoring in Poland, 1962, 18: 20211 (CLOR-24)
monitoring in Sweden, 1959, 1962, and 1963, 18: 20212 (NP-13846)
monitoring of iodine-131 content in green leafy vegetables in Germany, fall 1962, 18: 19810
radioactive rainout relations in sampling networks in Illinois, 18: 20617 (COO-1199-3)
recovery of facilities exposed to, 18: 20237 (USNRDL-TR-700)
strontium-90 accumulation in man from, 18: 20235 (NP-13868)
FAST REACTORS
control of ANP open-cycle, 18: 21561 (APEX-603(Del.))
fuel development for, 18: 21698(R) (ANL-6860)
neutron Doppler coefficient for, using plutonium oxide fuel, 18: 21593 (APDA-157)
neutron inelastic scattering matrices for, revised, 18: 21598 (IA-899)
safety studies, 18: 21698(R) (ANL-6860)
FATTY ACIDS
analytical uses for gravimetric determination of hafnium and zirconium, 18: 19871
FECES
analysis for fission products from fallout in Japan, 1962 and 1963, 18: 20232 (JAERI-1057)
FERMI FAST BREEDER REACTOR
containment in nuclear accidents, 18: 21641 (NP-13793)
FERMIONS
collective excitations of systems of, two-particle approximation for, 18: 20980
decay of, conserved vector current theory for, 18: 21306
field theory for, spinors in, 18: 21024
interactions at high energies, cross sections for, 18: 20990
interactions with bosons, Regge trajectories of backward-angle differential cross sections for, 18: 20942
spin orientation of charged spin-½ particle in time-independent electric and magnetic fields, effects of pseudoscalar charge density on, 18: 20946
theory of systems of, Meissner effect and flux quantization in, 18: 20667
vacuum trajectory in conventional field theory, 18: 21063
FERMIUM ISOTOPES Fm-248
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
FERMIUM ISOTOPES Fm-250

energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
FERMIUM ISOTOPES Fm-252
energy levels of, properties of octupole, 18: 21172 (JINP-E-1561)
FERMIUM ISOTOPES Fm-254
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
FERRICYANIDES
reactions with borohydride ions in aqueous solutions, kinetics of, 18: 19938 (UCRL-11252)
FERRITES
Cherenkov radiation emission from anisotropic, 18: 20775
FERROCENES
properties for use in gamma detectors, 18: 20402
radiolysis, 18: 20402
FERROMAGNETIC MATERIALS
diffusion constants of, elasticity effects in, 18: 20637 (UCRL-7290-T)
superconductivity in, 18: 21106
FIELD LABORATORIES
asymptotic relations between scattering amplitudes in relativistic local quantum, 18: 20907 (JINR-P-1564)
FIELD THEORY
book: *Quantum Field Theory and the Many-Body Problem*, 18: 21067
bound states in potential theory, vertex renormalization constants for, 18: 21038
classification of baryons and leptons in SU(4), 18: 20931
eigenstates of pairing-force Hamiltonian for many-boson system with N-body interaction in, 18: 21034
eigenvalue of ground-state three-body system in, upper and lower bounds of, 18: 21048
eightfold-way symmetry in, unitary triplets in, 18: 21045
electromagnetic interactions of Yang-Mills field, 18: 21062
elementary-particle mixing in, pole approximations in, 18: 20947
Feinberg-Pais weak interactions in, strong-interaction effects in, 18: 20950
Feynman rules for massless particles of arbitrary spin in relativistic, 18: 20944
formalism for elementary particles, 18: 21024
formulation of dynamic laws in the quantum theory of fields, 18: 21023 (NP-13878)
functional integration techniques in quantum, 18: 21065
high-energy collisions of strongly interacting particles, 18: 20971
invariant distributions of quantum, analytic representation of, 18: 21068
mass vector for unitary symmetry octets in, mass sum rules from, 18: 20939
matrix elements of the octet operator of SU_3, 18: 20922
model for relativistic, with scalar bosons interacting via a simple scalar vertex, 18: 21039
non-Abelian vector gauge fields and the electromagnetic field, 18: 21060
of electrons and phonons, 18: 21066
pseudoscalar charge density of spin-½ particles in, observability of, 18: 20946
quantization of self-coupled boson field, 18: 21002
quantum theory of a generalized Yang-Mills field, 18: 21069
quantum, axioms for multilocal, 18: 21056
Regge trajectories for baryons and nucleons in, model for, 18: 20940
scattering by strongly singular potentials in, weak-coupling limit for, 18: 21049
scattering of two pseudoscalar SU(3) octet mesons in, even-signature Regge poles in bootstrap dynamics of, 18: 21042
spin field interactions in, 18: 21064
symmetry-breaking processes in strong-interaction, 18: 20941
three-particle final-state interactions in, dispersion theory of overlapping resonant, 18: 21044
universal Fermi interaction and the conserved vector current in beta decay, 18: 21306
vacuum trajectory in conventional, 18: 21063
FILMS
mechanical properties of thin, review, 18: 20515 (CONF-356-11)
FILTERS
efficiency of Poelman Schneider pink, determination using radioactive aerosol, 18: 20239(T) (NP-tr-1124)
testing of efficiency of aerosol, by oil mist method, 18: 21738(T) (UCRL-Trans-1045)
testing of high-efficiency, development of tracer system for in-place, 18: 20450(R) (BMI-1661(Del.))
FINNED TUBES
design and fabrication, 18: 20506(P)
FISH
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
radiation and antibiotic effects on scale homograft survival in, x, 18: 19726
radiation effects on goldfish blood, organs, and bones, 18: 19756
radioactivity of carp, effects of environment on, 18: 19517
FISSION
distributions from, relations between charge and mass, 18: 21195 (KR-64(Sect.XVI))
distributions of delayed neutrons from, 18: 21196 (KR-64(Sect.XVII))
mechanisms for binary, models and theories for, 18: 21186 (KR-64 (Sect.II))
models for binary and ternary, 18: 21280
pressure wave generation in gaseous, 18: 21268
theory of beta decays and delayed gammas following, 18: 21297
theory of, lectures on, 18: 21194 (KR-64(Sect.XV))
FISSION CHAMBERS
development and testing of high-temperature, 18: 21564(R) (GEMP-81)
FISSION PRODUCTS
analysis of beams of, design of mass spectrograph for, 18: 20311
analysis of beams of, performance of mass spectrograph for, 18: 20312
beta decay and delayed gammas from, 10^{-3} to 10 sec after fission, 18: 21297
detection and measurement using silver halide nuclear emulsions, 18: 20414
determination in diet and excreta in Japan, 1962 and 1963, 18: 20232 (JAERI-1057)
determination in sea water, 18: 19837(R) (MIT-905-1)
fixation of long-lived waste, demonstration facilities for, 18: 21691 (HW-77163)
food crop contamination by fallout, mathematical analysis of, 18: 19515 (NP-13796)
kinetic energy and mass distribution as a function of prompt fission gamma-ray energy in uranium-235, 18: 21343
mass distributions for thermal-neutron binary and ternary fission of uranium-235, 18: 21280
neutron emission by individual, 18: 21197 (KR-64(Sect.XVIII))
radioactivity of, in Columbia River sediment, 18: 20219
release from coating materials, 18: 20450(R) (BMI-1661(Del.))
release of gaseous, from irradiated uranium carbides, 18: 20450(R) (BMI-1661(Del.))
release of gaseous, from irradiated coated fuel particles, 18: 20450(R) (BMI-1661(Del.))
separation by sorption on ferric hydroxide, 18: 20102 (UJV-850/63)
separation from acid solutions by solvent extraction using degraded kerosene–HNO_3–TBP, 18: 20100 (ORNL-3524)
separation from gaseous reactor coolant, process plant for, 18: 21584(P)
FISSION RECOILS
angular and energy distribution of, ionization chamber for measuring, 18: 20392
effects on lithium fluoride crystals, 18: 20450(R) (BMI-1661(Del.))
effects on thermionic cell gases, ionization in, 18: 20860
FISSIONABLE MATERIAL
facilities for, British law for, 18: 20247
neutron distributions in, theory of prompt-decay constants and spectra for, 18: 21149
neutron distributions in, prompt-decaying eigenstates for thermal and slowing-down range in, 18: 21150
pressure wave generation in gaseous, 18: 21268
FLUID FLOW
analysis of open matrix boiling water reactor core using IBM 7090, 18: 21557 (NAA-SR-Memo-9444)
boiling patterns in, in vertical pipes, 18: 20176 (TID-7694(p.44-51))
conference on two-phase flow problems, Brussels, Oct. 29 to 31, 1962, 18: 20168 (TID-7694)
flow of conducting viscous fluid between parallel plates, 18: 20660

heat transfer by two-phase, 18: 20177 (TID-7694(p.53-60))
heat transfer by vortex two-phase, in boiling reactors, 18: 20181 (TID-7694(p.89-107))
heat transfer in forced convection water, critical, 18: 20190
heat transfer in two-phase, 18: 20169 (TID-7694(p.7-10))
heat transfer in two-phase, 18: 20170 (TID-7694(p.11-17))
heat transfer in two-phase, 18: 20182 (TID-7694(p.108-49))
heat transfer of two-phase liquid-metal, in straight-tube and swirl, 18: 20160(R) (AD-423679)
heat transfer of two-phase liquid-metal, in straight-tube and swirl, 18: 20166(R) (NP-13810)
heat transfer to liquid metals in cross-flow through rod bundles, 18: 20185
hydrodynamics of two-phase, 18: 20182 (TID-7694(p.108-49))
in boiling reactors, control device for two-phase, 18: 20173 (TID-7694(p.35-6))
in electric field, electric power generation by, 18: 20833 (GA/PHYS/63-11, 12)
magnetohydrodynamic, past nonconducting walls, 18: 20650
magnetohydrodynamic, equations for, 18: 20677
of conducting fluid in plane channels, 18: 20659
pressure drops in steam–water mixtures flowing up in vertical tubes, 18: 20164 (EURAEC-1004)
pressure losses in two-phase, 18: 20175 (TID-7694(p.42-3))
slug, in capillaries and noncircular passages, 18: 20174 (TID-7694 (p.37-41))
stability of dissipative Couette, between rotating cylinders in presence of axial magnetic field, 18: 20191
stability of, bibliography on, 18: 20621 (AFCRL-62-1075)
transient behavior of two-phase forced-circulation, in channels permitting cross-flow, 18: 20165 (NAA-SR-Memo-8123)
two-phase, isokinetic sampling probe for phase and velocity distribution measurements near conduit wall in, 18: 20163 (EURAEC-952)
two-phase, through vertical venturi, 18: 21573 (NYO-10475)
two-phase, void fraction measurements in cavitating mercury using gamma densitometer, 18: 20167 (NP-13812)

FLUID FLOW (LAMINAR)

heat transfer to annular, 18: 20186
stability of film-boiling two-phase, in cryogenic systems, 18: 21119

FLUID FLOW (TURBULENT)

heat transfer to slug flow in annuli, 18: 20186
velocity measurements for SNAP-8 tri-cusp channel by salt velocity technique, 18: 21671 (NAA-SR-Memo-9232)

FLUIDS

shock-wave stability in conducting, MHD, 18: 20649

FLUOBORATES

s-butyldimethylsulfonium-α-s-, solvolysis in sulfuric acid solutions at 99.2°C, 18: 19837(R) (MIT-905-1)

FLUORENE

alpha and electron excitation of, pulse-height ratios for, 18: 20408

FLUORIDE VOLATILITY PROCESSES

development of fluid-bed, 18: 21698(R) (ANL-6860)

FLUORIDES

analysis for chromium by amperiometric titration, 18: 19869

FLUORINE

meson (π) diffraction dissociation on, 18: 20891 (AD-433625)
neutron total cross sections at 2.77 Mev, 18: 21159 (CEA-2399)

FLUORINE IONS

wave functions for $1s^22s2p^5$ configuration of, self-consistent, 18: 20759

FLUORINE ISOTOPES F-19

alpha reactions (α,pγ) at 4.7 to 5.5 Mev, angular correlations in, 18: 21246
deuteron reactions (d,α) at 2.5 to 3.3 Mev, angular distributions from, 18: 21241
deuteron reactions (d,α) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
energy level at 198 kev, nuclear quadrupole moment of, 18: 21276
nuclear magnetic resonance in hexafluoropropene sorbed on alumina, 18: 20632 (TID-18689)
triton reactions (t,p) with, fluorine-21 energy levels from, 18: 21255

FLUORINE ISOTOPES F-20

beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
beta decay of, circular polarization of gamma radiation following, 18: 21309

FLUORINE ISOTOPES F-21

energy levels, 18: 21255

FLUOROFORM

reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)

FLUOROMETRY

developments in, review of, 18: 19858

FONTENAY-AUX-ROSES REACTORS

environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)

FOOD

analysis for radioactivity by FDA, program for, 18: 20255
contamination of, by plant uptake of fission products from soil, 18: 19515 (NP-13796)
iodine-131 content of green leafy vegetables in Germany, fall 1962, 18: 19810
radiation effects on microflora in canned fish, meat, and peas, gamma, 18: 19558(T) (JPRS-24187)
radiation effects on pork meat, heat treatment effects on gamma, 18: 19617
radiation effects on pork meat, heat treatment effects on gamma, 18: 19616
radiation preservation of, bibliography on, 18: 20423
radiation processing for preservation, survey of, 18: 19658
radiation processing of beef, study of over-tenderizing from, 18: 19758
radioinduced free radicals in fats, gamma, 18: 20086
radioisotope uptake from, in Alaska, 18: 20231 (HW-SA-3048)
strontium-90 content in, effects of cooking on, 18: 20238(T) (JPRS-24139)
zinc-65 metabolism in mouse livers, effects of, 18: 19531

FRANCE

environmental radioactivity at reactor sites in, 1961 and 1962, 18: 20209 (CEA-2397)

FREE RADICALS

radioinduced formation in dilute acid, basic, and neutral solutions, review of, 18: 20037 (BNL-6978)
radioinduced formation in benzene, biphenyl, naphthalene, and toluene, 18: 20042 (USNRDL-TR-718)
radioinduced in fats, electron spin resonance studies of, 18: 20086

FROGS

radiation effects on cardiac activity in, beta, 18: 19564
radiation effects on anesthetized, x, 18: 19612(T)
radiation effects on, repair of, x, 18: 19781(T)
radioactivity of, effects of environment on, 18: 19517

FURANS

tetrahydro-, spectra of uranium tetrachloride in, absorption, 18: 19935 (TID-18814)

FURNACES

design and performance of centrifugal plasma-jet, 18: 20157

G

GADOLINIUM

content and relative abundances in terrestrial materials, 18: 20202
determination in thorium using xylenol orange, spectrophotometric, 18: 19883
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
electron structure of, measurement from positron annihilation, 18: 20552
performance as poison for ANP open-cycle reactor, 18: 21561 (APEX-603(Del.))
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
shielding properties, 18: 21543 (BMI-1384)

GADOLINIUM ALLOYS

Gd–La, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)

GADOLINIUM CHLORIDES

paramagnetic properties of hexahydrate of, at low temperatures,

18: 19988
GADOLINIUM FLUORIDES
analysis for oxygen, 18: 19907
GADOLINIUM IONS
hyperfine structure interaction of trivalent, with 87-kev state of gadolinium-155 in magnetic field, 18: 21211 (PAN-299)
paramagnetic resonance of trivalent, in zircon, 18: 19945
GADOLINIUM ISOTOPES Gd-151
decay and half life, 18: 21348
GADOLINIUM ISOTOPES Gd-153
decay and half life, 18: 21348
electron-capture decay of, gamma spectrum from, 18: 21271
GADOLINIUM ISOTOPES Gd-154
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
GADOLINIUM ISOTOPES Gd-155
energy level at 87 kev, hfs interaction with trivalent gadolinium in magnetic field, 18: 21211 (PAN-299)
energy level transition (182 + 180) – 87 kev of, effects of magnetic fields on angular correlations and hfs interaction of, 18: 21211 (PAN-299)
GADOLINIUM ISOTOPES Gd-156
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
GADOLINIUM ISOTOPES Gd-157
neutron reactions with, resonances in, 18: 21164 (CONF-481-36)
GADOLINIUM ISOTOPES Gd-158
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
GADOLINIUM ISOTOPES Gd-160
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
GADOLINIUM OXIDES
analysis for oxygen, 18: 19907
GALACTOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
GALAXIES
dynamics and galactic halo, 18: 20724
magnetic field in M82 exploding, 18: 20718
GALENAS
lead isotopic content in, 18: 20430
GALLIC ACID, PROPYL ESTER
protective effects against radiation injuries in mice, 18: 19797
GALLIUM
alloying effects on corrosion of magnesium and magnesium–neodymium alloys, 18: 20482
effects on superconductivity of niobium–tin alloys, 18: 21110
performance as reactor coolant, evaluation of, 18: 20192
separation from chloride solutions by solvent extraction using tridodecylaminehydrochlorides, 18: 19837(R) (MIT-905-1)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
superconductivity of modification formed at 35000 atm and 6.38°K, 18: 21108
GALLIUM ALLOYS
Ga–Pu, thermoelectric power of phase transformations in, 18: 20527 (RFP-351)
Sb–Ga, photoelectric and sorptive properties, 18: 20564
GALLIUM ARSENIDES
surface contamination of, use of radioisotopes for detection of, 18: 20420
GALLIUM CHLORIDES
separation from lithium chloride solutions by solvent extraction using tetraheptylammonium chlorides, 18: 19837(R) (MIT-905-1)
separation from lithium chloride solutions by solvent extraction using tridecylaminehydrochlorides, effects of temperature on, 18: 19837(R) (MIT-905-1)
GAMMA-ABSORPTION ANALYSIS
use in determination of carbon-hydrogen ratio of hydrocarbons, 18: 19904
GAMMA RADIATION
angular correlations in proton inelastic scattering, 18: 21252
attenuation in thermal shielding for power reactors, calculation of, 18: 21636 (HW-72844)
biological effects of, relative, 18: 19685
biological effects on cartilages of growing larynx in rabbits, 18: 19700
chemical effects on β-cyanoethyl acrylate, ethyl vinyl sulfone, and other monomers, 18: 20450(R) (BMI-1661(DeL))
chemical effects on 1-bromobutane–tin mixtures, 18: 20450(R) (BMI-1661(DeL))
chemical effects on 2,2,4-trimethylpentane, 18: 20079
chemical effects on fats, free radicals produced in, 18: 20086
chemical effects on carbon monoxide in presence of rare gases, 18: 20087
chemical effects on carbon tetrachloride–white phosphorus reactions, 18: 20091
chemical effects on cyclopentasone and cyclopentanone mixtures, 18: 20093
chemical effects on solid solutions of propionamide and acrylamide, 18: 20094
chemical effects on quartz-glycine solutions, 18: 20045
chemical effects on benzene solutions, 18: 20047
chemical effects on glucosamine, 18: 20049
chemical effects on water, 18: 20050
chemical effects on methylacetylene and phenylacetylene, 18: 20052
chemical effects on deuterated toluene, 18: 20053
chemical effects on benzene–toluene mixtures and their deuterated systems, 18: 20054
chemical effects on toluene, relation of linear energy transfer and yields in, 18: 20055
chemical effects on hydrocarbons, mechanism of hydrogen formation in, 18: 20057
chemical effects on α-methylstyrene, 18: 20070
cytological effects in human marrow, 18: 19602
detection and measurement in man, whole-body, 18: 20337 (NYO-2553-1)
detection and measurement of, efficiency of sodium iodide crystals for, 18: 20076
detection and measurement using organic scintillators, gamma-neutron discrimination in, 18: 20350
detection and measurement using cadmium sulfide detector, 18: 20351
detection and measurement using semiconductor detectors, 18: 20413
detection and measurement of, ionization chamber for, 18: 20394
detection and measurement of, properties of ferrocene for use in dosimeters for, 18: 20402
dose rate behind shielding plugs in Battelle shielding facility, 18: 21543 (BMI-1384)
effects of auxotropic mutants in *Coliform bacterium*, 18: 19688
effects on animals, protective effects of bone marrow against, 18: 19769
effects on Anopheles fertility, 18: 19654
effects on apple tree chimeras, 18: 19567
effects on bacteriophage T1, effects on freeze-drying, low temperature, and sulfhydril compounds on, 18: 19634
effects on blood count from telecobalt radiotherapy, 18: 19749
effects on cherry graft development, 18: 19691
effects on chicken fertility and hatchability after sperm irradiation, 18: 19664
effects on chromosomes of *Hymenolepis diminuta*, 18: 19752
effects on cotton seedlings, 18: 20418
effects on dielectric properties of rubber, 18: 20589
effects on *E. coli*, 18: 19686
effects on electronic components, 18: 20590
effects on engineering materials in vacuum and/or at cryotemperatures, 18: 20581(R) (FZK-172)
effects on ESR spectra of beryllium oxide single crystals, 18: 20614
effects on extractables from food-packaging materials, 18: 19889
effects on femur in radiotherapy of adenocarcinoma of uterus, 18: 19713
effects on green and yellow excited absorption spectra of cuprous oxides, 18: 20077
effects on growth-phases of *Pseudomonas sp.*, 18: 19628
effects on guinea pigs, protective effects of leukocyte transfusions against, 18: 19776
effects on human chromosomes, 18: 19582
effects on human kidney cells, methods for modification of, 18: 19760
effects on lead flint glass at elevated temperature, 18: 20586
effects on leukocytosis in rabbits, 18: 19697
effects on microflora in canned fish, meat, and peas, 18: 19558(T) (JPRS-24187)
effects on mouse hematopoietic cells, repair of, 18: 19761
effects on mouse immunity to sheep erythrocytes, 18: 19623

effects on mouse lethality compared with fission neutrons, 18: 19576
effects on mouse mitosis, gamma, 18: 19609(T)
effects on mouse mitosis, gamma, 18: 19610(T)
effects on nicotiana plant development and nicotine content, 18: 19690
effects on nuclear diameters of cells of Walker carcinomas, 18: 19699
effects on optical masers, 18: 20625 (N63-21469)
effects on polyvinylpyrrolidone, protective effects of thiourea against, 18: 20056
effects on pork, heat treatment effects on, 18: 19616
effects on pork, heat treatment effects on, 18: 19617
effects on proteolysis in rat kidneys and skeletal muscles, 18: 19745
effects on *Pseudomonas sp.*, 18: 19627
effects on rabbit testes and reproductive capacity, 18: 19755
effects on rat ears, 18: 19562
effects on rat lungs after ATP and rutin application, 18: 19807
effects on rat serum proteins, temperature effects on, 18: 19642
effects on rat submucosal tissue, protective effects of Tanderil (oxyphenylbutazone) against, 18: 19803
effects on reactor neutron counting with in-core ion chamber, 18: 21563(R) (GEAP-4483)
effects on regenerative processes related to blood letting in rabbits, 18: 19611(T)
effects on rocket reactor thermal control materials, 18: 20603
effects on skin in teletherapy using cesium-137, 18: 19716
effects on static breakdown voltage in air, 18: 20602
effects on teflon, 18: 20592
effects on transplanted lymphoma cell sensitivity, assay method for, 18: 19671
effects on urinary excretion of amino acids, 18: 19638
effects on vitamin B_{12} in mice, 18: 19743
emission by nuclei, spectral analysis of, 18: 21202 (KR-64(Sect.XXXII))
emission following thermal neutron capture by nuclei, 18: 21193 (KR-64(Sect.XIV))
emission following neutron capture, correlations in, 18: 21199 (KR-64(Sect.XXI))
emission from building materials, 18: 20210 (CLOR-20)
emission of polarized, following polarized-neutron capture in nuclei, 18: 21200 (KR-64(Sect.XXII))
erythropoietic effects in rats, 18: 19593
hematopoietic effects on guinea pigs, tracer studies of effects of postirradiation bleeding on, 18: 19717
histochemical effects on enzyme activity of cells of cervix carcinoma and surrounding cells, 18: 19701
interactions with mesons (π), (π-σ) production in, 18: 20921
leukemogenic effects in mice, physical factors affecting, 18: 19577
mitotic effects on malignant and nonmalignant epidermal hyperplasia in mice, 18: 19704
mutagenic effects in Drosophila, dose-rate effects on, 18: 19646
polarization in emission after beta decay, 18: 21309
polarization of, from oriented nuclei, 18: 21274
production in neutron reactions, cross sections for, 18: 21169 (GEMP-278)
reactions (γ,α) and (γ,4α) with oxygen-16, 18: 21224
reactions (γ,n) with lanthanum-139 and praseodymium-141 up to 30 Mev, cross sections for, 18: 21278
reactions (γ,n) with copper-63 and oxygen-16 at 13 to 66 Mev, yields from, 18: 21308
reactions (γ,n) with oxygen-16, sulfur-32, and calcium-40, neutron energy spectra from, 18: 21257
reactions (γ,pt) with carbon-12 at 30 to 80 Mev, nucleon cluster model for, 18: 21247
reactions (γ,3α) with carbon-12, 18: 21224
scanner for, digital printout system for whole-body, 18: 20346
scanning system for, whole-body, 18: 19818
scattering and transport of, Monte Carlo programs for calculating, 18: 20932
scattering of, method for calculating nonstationary multiple Compton, 18: 20920
scintillator quenching by, 18: 20352
spectra of 0.1- to 2-Mev atmospheric, 18: 20411
therapy of breast carcinomas using, effects on bones, 18: 19673
transmission in slabs, computer program for calculating, 18: 21544 (BRL-Memo-1223)
use in ethyl bromide production, equipment and process development and operation for, 18: 20048

GAMMA SOURCES
production for radiography, 18: 20421

GAMMA SPECTRA
analysis and decomposition of, methods for, 18: 21202 (KR-64 (Sect.XXXII))
analysis of sum-coincidence, for detection of fictitious cascades, 18: 21251
analysis of, computer methods for, 18: 21248
Mössbauer effect on line broadening in Gaussian, 18: 21315

GAMMA SPECTROMETERS
characteristics of bent- and flat-crystal, 18: 20333 (KR-64(Sect.XX))
design, 18: 20411
design and performance of 4-channel, portable, 18: 20347
design and theory of pair, 18: 20342 (UCRL-10781)
design of high-resolution, using germanium detectors, 18: 20374
design of integrated coincidence, 18: 20386
design of scintillation coincidence, 18: 20331 (KR-64(Sect.X))
efficiency of silicon detectors in low-energy, 18: 20373
energy resolution of scintillation-type, 18: 20387

GAMMA SPECTROSCOPY
analysis of sum-coincidence, for detection of fictitious cascades, 18: 21251

GAS COOLED REACTORS
bearing development for helium atmosphere in, 18: 21575
control system for, 18: 21579
coolant flow direction in, selection of, 18: 21611
design of graphite-moderated, 18: 21646
feasibility of pebble-bed, 18: 21658
fuel element design with purge gas circuit for high-temperature, 18: 21664(P)
fuel element support in, by graphite jackets, 18: 21618
loading and unloading machine for, 18: 21586(P)
loading system for, integrated, 18: 21578
moderator assemblies of, design and stability of graphite, 18: 21577
neutron diffusion anisotropy in media with empty channels, thermal, 18: 21141
pressure tube assembly design for, with flow-limiting device in case of rupture, 18: 21585(P)
pressure vessels for, concrete and metal, 18: 21576
shutdown device for, 18: 21588(P)

GAS FLOW
magnetogasdynamic constant Mach number duct equations, 18: 20839
research progress on nonequilibrium, 18: 20119 (ARL-64-5)
stability of, bibliography on, 18: 20621 (AFCRL-62-1075)
velocity of heated, method for measuring, 18: 20188

GASEOUS DIFFUSION PROCESS
barrier fabrication for, 18: 20437(P)

GASEOUS FUEL REACTORS
fuel thermodynamics, 18: 21268

GASES
analysis for water vapor using carbon-14-labeled calcium carbide, 18: 19848 (ORO-591)
correlation functions of classical, cluster property of, 18: 21059
detonation wave stability in ideal, 18: 20648
electric breakdown at optical frequencies, mechanisms for, 18: 21513
electric conductivity of ionized, in magnetic field, 18: 20661
ionization phenomena in, conference on, 18: 20671
kinetic theory of weakly coupled, 18: 21376 (MATT-238)
model of confined classical imperfect, soluble, 18: 20655
neutron transport in semi-infinite nonabsorbing, energy-dependent Milne problem for, 18: 21144
shock waves in, microwave studies of electrically driven, 18: 21448
gas–liquid, phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)

GASKETS
mold development for neoprene, 18: 20134(R) (ORNL-TM-792)

GASTROINTESTINAL TRACT
radiation effects on abdominally irradiated rats with shielded, x, 18: 19587

radiation effects on inulin permeability, 18: 19718
GEIGER-MUELLER TUBES
design of, with post-accelerator, 18: 20361
performance of, improvements in, 18: 21709(R) (MLM-1179)
stability of, methods of assuring, 18: 20381
GELATIN
spectra of sol-gel transition in deuterated, infrared, 18: 19982
GENES
evolution of mutant, effects on population dynamics of Drosophila, 18: 19506(R) (TID-20401)
for radioresistance in *E. coli*, locus for, 18: 19619
gametophyte-dependent variation in maize, 18: 19507 (TID-20402)
radioinduced Drosophila mosaic, x, 18: 19618
GENETICS
effects on induction of hypertension by excess salt ingestion in man and rats, 18: 21702 (BNL-7971)
pattern determination control in Drosophila, 18: 19618
radiation effects on Tradescantia, model for relation of, to LET, 18: 19573
radiation effects on fertility of male mice, protection against, using serotonine, 18: 19711
radiation effects on *E. coli* recombination, after female irradiation, 18: 19620
theory of, informational model of probability in, 18: 19512
GEOCHEMISTRY
book: *Progress in Isotope Geology*, 18: 20207
GEOLOGY
book: *Progress in Isotope Geology*, 18: 20207
cavity and chimney formations in underground explosions in alluvium, granite, rock salt, and tuff, 18: 20122 (UCRL-7711)
rare earth content and relative abundances in terrestrial materials, 18: 20202
uranium emplacement in Lisbon Valley, Utah, 18: 20228
GEOMAGNETIC FIELDS
cosmic particle motion in, 18: 20822
electric current generated by, 18: 21083
intensity of, magnetometer for measuring, 18: 20288
interactions with solar corpuscular radiation, 18: 20722
micropulsations of, production by hydromagnetic waves in lower exosphere, 18: 21076
nuclear explosion effects on, 18: 21085
synchrotron radiation from electrons trapped in, 18: 21086
GEOMAGNETIC STORMS
cosmic neutron intensity dependence on latitude during, 18: 20818
occurrence tendency of local high-latitude, during IGY, 18: 21079
GEOPHYSICS
radiometric techniques in, 18: 20225
thermal history of the earth and origin of a solid inner core, 18: 21074
GERMANIUM
analysis for oxygen, comparison of activation and vacuum fusion methods, 18: 19922
drifting gamma detectors of, automatic apparatus for lithium-, 18: 20344 (UCRL-11261)
effects on superconductivity of niobium–tin alloys, 18: 21110
electron emission from electrodes of semiconducting, 18: 20152
ion reactions at 4 to 100 ev, Auger electron yield in, 18: 20780
neutron inelastic scattering by, cold, 18: 21121 (BNL-7958)
performance of lithium-drifted, for gamma spectroscopy, 18: 20374
properties as semiconductor detector, 18: 20376
properties of lithium-drifted, 18: 20375
properties of semiconductor detectors of, 18: 20377
radiation effects on, annealing of defects produced in pulsed fast electron, 18: 20583 (PAN-473/II)
surface contamination of, use of radioisotopes for detection of, 18: 20420
GERMANIUM ALLOYS
Ge–Au, phase studies of nonequilibrium structures in rapidly quenched, 18: 21727 (TID-20489)
GERMANIUM JUNCTIONS
performance as fast-neutron and gamma-ray detectors, 18: 20413
GERMANIUM OXIDES
GeO_2–Nb_2O_5, crystal structure of tetragonal phases in, 18: 19942
GERMANY
iodine-131 content in green leafy vegetables in, fall 1962, 18: 19810
radioactivity of milk in, Sept. 1961 to Sept. 1962, 18: 19809
GLASS
cutting of, design of machine for, 18: 20134(R) (ORNL-TM-792)
sealing to Zircaloy-2, development of methods for, 18: 20134(R) (ORNL-TM-792)
GLOBINS
x-ray scattering by metmyoglobin, cross sections for, 18: 20035
GLOBULIN
radiation effects on rat blood serum, temperature effects on, gamma, 18: 19642
radiation effects on, in animals irradiated at 3270 to 5400 r, 18: 19703
GLOW DISCHARGES
theory, 18: 21454
GLUCOSAMINE
radiation effects on, gamma, 18: 20049
GLUCOSE
NH_4Cl–glucose, effects of irradiated, on *Pseudomonas sp.*, 18: 19627
oxidation by bromine, tritium isotope effects in, 18: 20031
GLUTAMINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
GLYCEROL
protective effects in Serratia against x radiation, 18: 19785
GLYCINE
effects on hippuric acid synthesis in irradiated rat liver, 18: 19631
radioinduced reactions with quartz, nitrate formation in, 18: 20045
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
GLYCOGEN
radiation effects on mouse blood cell metabolism of, x, 18: 19730
radiation effects on mouse phagocyte, x, 18: 19734
radiation effects on mouse splenic leukocyte content of, when used with antigens, x, 18: 19741
radioinduced castration effects on, x, 18: 19731
GLYCOLYSIS
effects on transplantability of ascites tumor cells, 18: 19651
GOATS
calcium-45, phosphorus-32, and strontium-89 content in blood plasma of, method for establishing constant, 18: 19541
GOLD
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)
neutron scattering at 300 to 1500 kev, 18: 21698(R) (ANL-6860)
reflectance of crystalline, 18: 19837(R) (MIT-905-1)
separation from chloride solutions by solvent extraction using tridodecylaminehydrochlorides, 18: 19837(R) (MIT-905-1)
sputtering by argon at 40 to 80 kev, angular and energy distribution from, 18: 20783
sputtering by xenon at 25 to 60 kev, energy dependence of, 18: 20785
stacking-fault energy, 18: 20550
GOLD ALLOYS
Au–Rh–Ti, superconductivity, 18: 21112
Au–Sn, tin-119 Mössbauer effect in, 18: 20007
Ge–Au, phase studies of nonequilibrium structures in rapidly quenched, 18: 21727 (TID-20489)
GOLD ELECTRODES
electric breakdown and electron emission in vacuum, mechanisms of, 18: 20139
GOLD ISOTOPES Au-199
energy levels, 18: 21243
GOLD SYSTEMS
CsO–Au, electron emission from discharge cathodes of, 18: 21452
GONADAL HORMONES
effects on cerium-144 distribution in mice, 18: 19545
GONADS
radiation dose to, after diagnosis, 18: 20264
radiation effects on rabbit testes and reproductive capacity, gamma, 18: 19755
radiation effects on testes of rats, 18: 19709
radioinduced castration of, effects on hematopoietic system, 18: 19731
GOODYEAR ATOMIC CORP., PIKETON, OHIO

environs monitoring, 1963, 18: 20230(R) (GAT-R-335)
GRANITE DEPOSITS (N.H.)
thorium concentration, alpha emitters, and radioactive disequilibrium in Conway, 18: 20222
GRANITES
explosions in, geologic factors in cavity and chimney formation in, 18: 20122 (UCRL-7711)
shock waves in, from Hardhat event, calculation, 18: 20125 (UCRL-7762)
GRAPHITE
ablation of, unified theoretical treatment of, 18: 20525 (R63SD89)
bremsstrahlung reactions at 44 and 56.5 Mev, production of beryllium-7 in, 18: 21328
coating of articles of, with glazed silicon carbide for oxidation resistance at high temperatures, 18: 20511(P)
defect structures in pyrolytic, evaluation of physicochemical, 18: 20542
deposition of coatings of pyrolytic, on fuel particles, 18: 20510(P)
design and stability of gas-cooled reactor assemblies of, 18: 21577
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
neutron spectra in, thermal, 18: 21146
oxidation at 350 to 500°C, effects of neutron irradiation and annealing on, 18: 20580 (BNL-7964)
radiation effects on thermal conductivity of pyrolytic, 18: 20450(R) (BMI-1661(Del.))
radiation effects on oxidation of, at 350 to 500°C of, neutron, 18: 20580 (BNL-7964)
reactions with uranium carbides, stabilization by uranium nitride, 18: 19923 (AERE-M-1360)
reactions with uranium at 800 to 1100°C, 18: 19984
surface area measurement of, by krypton sorption, 18: 19971
thermal conductivity, 18: 20539
GRAPHITE BROMIDES
boundary dislocations in interlamellar, electron microscopic studies of, 18: 19931 (EUR-542.e)
GRAPHITE ELECTRODES
fabrication and use of pyrolytic, in chronopotentiometry and voltammetry studies on iron, 18: 19966
use in voltammetric studies on cerium, chromium, manganese, and vanadium in sulfuric acid solutions, 18: 19967
GRAPHITE MODERATED REACTORS
coolant removal from upper plenum of 200-Mw(e) SGR, hydraulics of, 18: 21639 (NAA-SR-Memo-9241)
core hydraulic and thermal analyses for 1000-Mw(e) SGR alternate fuel, 18: 21616 (NAA-SR-Memo-9569)
design of gas-cooled, 18: 21646
fuel element grapple and hold-down-latch development for SGR, 18: 21638 (NAA-SR-Memo-8266)
lattice parameters versus pitch for ASCR closed lattices, 15-group diffusion study of, 18: 21600 (NAA-SR-Memo-9489)
material bucklings of ASCR, 18: 21599 (NAA-SR-Memo-9382)
moderator design, 18: 21577
GRAPHITE SYSTEMS
graphite–ICl, boundary dislocations in interlamellar compounds of, electron microscopic studies of, 18: 19931 (EUR-542.e)
graphite–$FeCl_3$, boundary dislocations in interlamellar compounds of, electron microscope studies of, 18: 19931 (EUR-542.e)
GRAVITATION
Mach's principle in, observational basis of, 18: 21057
radiation in massive star collapse, 18: 20715
GREAT BRITAIN
fallout monitoring in, 1961 and 1962, 18: 20208 (AERE-R-4415)
nuclear energy prospects and programs in, 18: 21740
nuclear installations act of, 18: 20247
radiation sources in, regulation of, 18: 20242
radiation used by universities in, code of practice for, 18: 20245
radioactive substances act of 1960, 18: 20246
strontium-90 content in diet, 1953 through 1961, 18: 20235 (NP-13868)
GRENOBLE REACTORS
environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)
GRINDING
equipment and methods development for, 18: 20134(R) (ORNL-TM-792)
surface, effects on stress corrosion cracking of austenitic stainless steel in dilute sodium chloride, 18: 20470 (CONF-492-1)
GROUND
electrical potential of, effects of underground nuclear explosion on, 18: 20200 (ARA-1054)
motion induced by underground explosions, effects on structures, 18: 20127 (UCRL-7773)
GROUND WATERS
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
GROWTH
radiation effects on rat bone, x, 18: 19555 (USNRDL-TR-721)
radiation effects on hamster lung cell, x, 18: 19670
radioinduced jute aberrant, beta and x, 18: 19725
GUANIDINE
radiolysis of, formation of carbon-14-labeled compounds in neutron, 18: 20092
GUANIDINE, 1,1'-(DITHIODIETHYLENE)DI-
protein-bonding, 18: 19773
radiation effects on mouse metabolism of 2-guanidoethyl-, x, 18: 19772
GUINEA PIGS
erythropoiesis in irradiated tracer studies of effect of postirradiation bleeding on, 18: 19717
ether and pilocarpine effects on iodine-131 secretion in thyroidectomized, 18: 19528
radiation effects on parotitis virus reproduction in, x, 18: 19556(T) (JPRS-23956(p.9-17))
radiation effects on lung enzymes in, x, 18: 19675
radiation effects on anesthetized, x, 18: 19612(T)
radiation effects on activity of esterases, lipids, and phosphatase in adrenal gland of, 18: 19710
radiation effects on tuberculosis in, 18: 19715
radiation effects on, protective effects of leukocyte transfusions against, gamma, 18: 19776

H

HAFNIUM
determination in tantalum, 18: 19920
determination simultaneously with thorium, titanium, and zirconium in ores, spectrographic, 18: 19912
determination using aromatic carboxylic acids, gravimetric, 18: 19871
elastic moduli at 0 to 1600°F from ultrasonic measurements, 18: 20196 (UCRL-7326)
electric quadrupole moment and electric field gradients in hafnium ammonium hexafluoride, 18: 21321
electron binding energies in, 18: 20766
HAFNIUM ALLOYS
Hf–Rh–Ti, superconductivity, 18: 21112
Hf–Ta–W, fabrication of T-111, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
HAFNIUM BORIDES
analysis for boron, carbon, hafnium, and silicon, 18: 19882
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
HAFNIUM CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
HAFNIUM FLUORIDE COMPLEXES
with ammonia, electric hyperfine structure interactions in, 18: 21321
HAFNIUM ISOTOPES Hf-176
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
HAFNIUM ISOTOPES Hf-178
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
HAFNIUM ISOTOPES Hf-180
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
HAFNIUM ISOTOPES Hf-181
gamma decay angular correlations of, in hafnium ammonium hexafluoride, 18: 21321
HAFNIUM NITRIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
emissivity measurements to 3000°K, equipment for, 18: 20567
HAFNIUM OXIDES
emittance and surface temperature measurement of coatings of, hot-

filament, 18: 20565
HAIR
radiation effects on rat, protective effects of cystamine and cysteamine against, x, 18: 19784
HALDEN BOILING REACTOR
fuel element development, 18: 21706(R) (KR-66)
HALL EFFECT
in magnetoplasmadynamic channel flow, energy conversion in, 18: 21410
HALLAM POWER REACTOR
core structural materials of, carburization surveillance of, 18: 21637 (NAA-SR-Memo-8214)
data reduction and analysis for, using IBM-7094 and SC-4020, 18: 21640 (NAA-SR-Memo-9391)
fuel element exposure calculations and contouring for, using IBM-7094 and SC-4020, 18: 21640 (NAA-SR-Memo-9391)
power calculations and contouring for, using IBM-7094 and SC-4020, 18: 21640 (NAA-SR-Memo-9391)
HALOHYDROCARBONS
mass spectra of excess-kinetic-energy ions in, 18: 20026
HAMBURG ELECTRON SYNCHROTRON
development, 18: 20695
HAMSTERS
radiation effects on, x, 18: 19672
uptake of tritium-labeled thymidine and uridine by cells of, effects of, on cell death, 18: 19645
HANDBOOKS AND MANUALS
clinical dosimetry recommendations of International Commission on Radiological Units and Measurements, 18: 19815 (NP-13856)
on radiobiological dosimetry, 18: 19549 (NP-13857)
training manual for Materials Testing Reactor, 18: 21682 (IDO-16871-2)
HARWELL SYNCHROTRON
development, 18: 20694
HASTELLOY C
corrosion by sodium at 1200°F material, 18: 20472 (NAA-SR-Memo-9340)
elastic moduli at 0 to 1600°F from ultrasonic measurements, 18: 20196 (UCRL-7326)
HASTELLOY X
corrosion by superheated steam, 18: 21668(R) (GEMP-274)
HAWAIIAN ISLANDS
lavas of, strontium-86/87 content in, 18: 20216
HAYNES 25 ALLOY
corrosion by mercury, 18: 21675 (NP-13795)
corrosion by mercury, tests of separator for products of, 18: 21677 (TID-20552)
HEALTH PHYSICS
measures for nuclear materials milling and mining, 18: 20267
measures for using sealed radiation sources, 18: 20243
radiation in universities, code of practice for, 18: 20245
regulations for radiation use, 18: 20249
HEART
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)
radiation effects on activity of frog, beta, 18: 19564
radiation effects on extracellular space in, 18: 19718
HEAT
effects of prior treatment with, on gamma radiation effects on pork, 18: 19616
effects of prior treatment with, on gamma radiation effects on pork, 18: 19617
HEAT EXCHANGERS
performance of double-pipe, 18: 21698(R) (ANL-6860)
HEAT EXCHANGERS (LIQUID-LIQUID)
design and performance for SRE, 18: 21571 (NAA-SR-Memo-9003)
HEAT-RESISTING ALLOYS
book: *Effect of Radiation on Metals and Other High-Melting Materials*, 18: 20601
HEAT TRANSFER
boiling burnout in liquid metal systems, 18: 20160(R) (AD-423679)
boiling burnout in rod bundle, effects of rod spacing on, 18: 20161 (AEEW-R-178)
boiling burnout in liquid metal systems, 18: 20166(R) (NP-13810)
burnout data correlations, 18: 20179 (TID-7694(p.85-6))
burnout in annular and nine-rod geometries, 18: 20172 (TID-7694 (p.24-34))
by liquid cesium and rubidium, design of loop for studying, 18: 19925(R) (AGN-8065)
by vortex flow in boiling reactors, 18: 20181 (TID-7694(p.89-107))
conference on two-phase flow problems, Brussels, Oct. 29 to 31, 1962, 18: 20168 (TID-7694)
critical heat flux at high pressure in rectangular channel, 18: 20172 (TID-7694(p.24-34))
critical, in forced convection water flow, 18: 20190
from fuel elements to water in boiling reactors, effects of vapotron claddings on, 18: 21617 (TID-7694(p.71-84))
in boiling and fog flow, 18: 21698(R) (ANL-6860)
in boiling reactors, 18: 20177 (TID-7694(p.53-60))
in flow of steam–water mixtures in vertical tubes, pressure drops in, 18: 20164 (EURAEC-1004)
in hollow cylindrical cell, 18: 20184
in two-phase flow, 18: 20169 (TID-7694(p.7-10))
in two-phase flow, 18: 20170 (TID-7694(p.11-17))
in two-phase flow, 18: 20171 (TID-7694(p.18-23))
in two-phase fluid flow, 18: 20182 (TID-7694(p.108-49))
radiation cooling of gas heated by a shock wave, 18: 21408(T)
to fluids flowing in annuli for slug and laminar flows, 18: 20186
to liquid metals in cross-flow through rod bundles, theory of, 18: 20185
transient behavior of two-phase forced circulation flow through channels permitting cross-flow, 18: 20165 (NAA-SR-Memo-8123)
HEAT TRANSFER SYSTEMS
description and performance of Large Component Test Loop for sodium, 18: 21570 (NAA-SR-Memo-8217)
design and development for studying refractory alloys in boiling and condensing alkali metals, 18: 20473(R) (NASA-CR-54008)
development and testing of liquid metal boiling, 18: 20160(R) (AD-423679)
development and testing of liquid metal boiling, 18: 20166(R) (NP-13810)
heating of, emitter temperature distribution in electron, 18: 20183 (TID-18835)
stability of boiling, thermal, 18: 20187
HEATERS
design of electron-bombardment, for sodium, 18: 20132 (NAA-SR-Memo-8289)
design of three-phase a-c arc, 18: 20129 (ARL-64-29)
HEAVY WATER REACTORS
design of steam-cooled power, 18: 21662(P)
design study of large, for sea water distillation and power production, 18: 21632 (DP-866)
development of light-water-cooled, 18: 21633(R) (DPST-64-83-1)
HELIUM
alpha-induced scintillations in liquid, 18: 20756
book: *Liquid Helium*, 18: 20789
burning in stellar red giants, 18: 20727
cavitation in liquid, ultrasonic induction of, 18: 20678
content in iron meteorites, 18: 20205
critical velocities in liquid, 18: 20797
dispersion in diffusion systems, quantum effects in, 18: 19961
effects on radioinduced dominant lethality in Drosophila oocytes, 18: 19622
electric discharge in, electric *vs* magnetic field hysteresis in, 18: 21403
electric discharge in, cathode electron emission in, 18: 21452
electric discharge in, excitation cross section from, 18: 21471
electric discharge in, ionization coefficient for, 18: 21472
electric discharge in, ionization coefficients for, 18: 21477
electric discharges in, properties of, 18: 20640
electron energy level quenching, optical 2^1S and 4^1P, 18: 20627(R) (NP-13815)
electron excitation cross sections of, absolute, 18: 20752
electron multiple scattering at 40 to 130 kev, linear displacement distributions in, 18: 21316
electron reactions with, excitation cross section for, 18: 21471
electron scattering by atomic, wave functions for, 18: 20735
energy limit for ground state of, radial correlations in, 18: 20739
energy transfer mechanisms in liquid, 18: 20756

excitation model for liquid, 18: 20790
flow in axial magnetic field, velocity of, 18: 21484
flow of liquid, in wide capillaries, 18: 20800
helium ion effects in liquid, 18: 20803
interactions with argon atoms, dipole-quadrupole effects on cross sections for elastic, 18: 20733 (WIS-TCI-41)
ion behavior in liquid, 18: 20805
ion mobility and structure in liquid, 18: 20804
lithium-7 scattering at 7 to 60 kev, angular distributions from, 18: 21318
motion of rotating liquid, equations of, 18: 20796
neutron inelastic scattering by liquid, cold, 18: 21121 (BNL-7958)
nuclear magnetic shielding constants for, 18: 21233
pinch discharge in, axial streams in Z, 18: 21531
pinch discharge in, electron density and energy in, 18: 21532
pinch discharge in, plasma behavior in linear high-current, 18: 21534
pinch effect in, effects of high initial pressure on, 18: 21419
pinch effect in, spectroscopic studies of, 18: 21422
plasma of, properties of, 18: 21368 (AFCRL-63-161)
plasma of, properties of weakly ionized, 18: 21375 (MATT-236)
plasma of, stability of a-c positive column of, 18: 21412
pressure variations and thermal conductivity in arc column of, in magnetic fields, 18: 21483
production in beryllium oxide by neutrons at 900°C, 18: 20605
reactions with helium atoms, excitation transfer in, 18: 20740
specific heat of liquid, near the λ-point, 18: 20793
spectra in artificial aurora, 18: 21073
spectra of afterglow of atomic, 18: 20737
spectra of afterglow of molecular, 18: 20738
superfluid flow of liquid, onset of friction in, 18: 20799
superfluidity, 18: 20791
theory of static film of liquid, 18: 20795
thermal conductivity and fountain pressure of liquid, 18: 20798
thermodynamic properties at 3 to 300°K and 0.5 to 100 atm, 18: 21095(R) (NBS-8239)
use in self-oscillating magnetometers, 18: 20294
vorticity in films of liquid, 18: 20794

HELIUM IONS
attenuation by silicon semiconductor detectors, 18: 20376
behavior in liquid helium, 18: 20805
decay of 2s state of, two-photon, 18: 20627(R) (NP-13815)
effects on density of surrounding liquid helium, 18: 20803
mobility and structure in liquid helium, 18: 20804
mobility in liquid helium, 18: 20803
reactions (He^3,d) with nuclei, analysis of, 18: 21204 (LADC-6302)
reactions with crystal surfaces at 4 to 100 ev, Auger electron yield in, 18: 20780
reactions with nitrogen and oxygen in ionosphere, 18: 21092
reactions with nitrogen and oxygen, cross sections and charge exchange rates for, 18: 20810
reactions with tungsten surfaces, electron ejection by, 18: 20777
sputtering on metals at 20 to 1000 ev, mass dependence of, 18: 20786

HELIUM ISOTOPES He-3
content in iron meteorites, 18: 20205
content in meteorites, 18: 20726
electric and magnetic form factors, 18: 21326
form factors, 18: 21019
He-3–He-4, velocity of fourth sound in, 18: 21114
meson (μ^-) capture by, rate of, 18: 21160 (CONF-231-5)
meson (μ) capture by, processes for, 18: 21326
performance in neutron spectrometers over wide spectral ranges, 18: 20359
production by cosmic-ray reactions with iron, magnesium, silicon, and sulfur in stony meteorites, 18: 20204
properties of liquid, below 1°K, 18: 20806
properties of liquid, near melting curve, 18: 20807
reactions (He^3,d) with nuclei, analysis of, 18: 21204 (LADC-6302)
reactions (He^3,n) with carbon-12 and -13 at 5.5 to 11 Mev, 18: 21259
reactions with boron-10, carbon-12, and nitrogen-13, excitation and resonances in, 18: 21336
scattering by nuclei at 20 Mev, differential cross sections for, 18: 21359
theory of liquid, 18: 20792
use as diffusion chamber filler, 18: 20390
use as vapor pressure thermometer, 18: 21708(R) (MLM-1178)
use in low-temperature thermometer, 18: 21709(R) (MLM-1179)
He-3–He-4, second sound in dilute mixtures of liquid, 18: 20802
He-3–He-4, thermodynamic properties of dilute mixtures of liquid, 18: 20801

HELIUM ISOTOPES He-4
compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
content in iron meteorites, 18: 20205
content in meteorites, 18: 20726
decay of ^{8}He, meson (π), 18: 20938
He-3–He-4, velocity of fourth sound in, 18: 21115
performance in neutron scintillation detectors, 18: 20398
thermal capacity of liquid, at boiling point, 18: 19929(CONF-417-20)
He-3–He-4, second sound in dilute mixtures of liquid, 18: 20802
He-3–He-4, thermodynamic properties of dilute mixtures of liquid, 18: 20801

HELIUM ISOTOPES He-6
energy levels of, calculation from nucleon interactions, 18: 21345

HELIUM SYSTEMS
He–O, radiolysis of, ozone formation in, 18: 20095

HEMATOLOGY
blood cell proliferation, differentiation, and maturation, 18: 19504 (BNL-7839)
quantitative bone marrow cell counts in rats, 18: 19510

HEMATOPOIETIC SYSTEM
physiology of, 18: 19504 (BNL-7839)
radiation and postirradiation bleeding effects on, in guinea pigs, 18: 19717
radiation effects on deoxyribopolynucleotide content in mouse, 18: 19630
radiation effects on dog, with decortication, x, 18: 19733
radiation effects on dog, with decortication, x, 18: 19733
radiation effects on phagocytes in mouse, x, 18: 19734
radiation effects on cells in mouse, repair of gamma, 18: 19761
radioinduced castration effects on, x, 18: 19731
tissue transplantation potential of, tracer study of, 18: 19527

HEMORRHAGE
protective effects of serotonin against, in radiation sickness, 18: 19696

HETEROGENEOUS REACTORS
neutron flux distributions in multiregion, 18: 21603
theory of, tridimensional, 18: 21560

HEXANE
radiolysis of, mechanism of hydrogen formation in, 18: 20057

HIGH-ALTITUDE EXPLOSIONS
geophysical effects, 18: 21085
hydromagnetic shock-wave propagation in exosphere from Argus III, 18: 21077
radio noise from nuclear, calculation of synchrotron, 18: 21086
radioisotope production in, 18: 21080
seismic wave propagation from, surface, 18: 21081

HIGH TEMPERATURE GAS COOLED REACTOR EXPERIMENT
fuel element design with purge gas circuit, 18: 21664(P)
fuel processing for, economics and methods of, 18: 20116
moderator for, economics and properties of beryllium as, 18: 21660

HIPPURIC ACID
radiation effects on rat liver synthesis of, effects of glycine on, 18: 19631

HIROSHIMA
carcinogenesis and leukemia in, 18: 19581
radioinduced carcinogenesis in, from atomic bomb explosion, 18: 19580
radioinduced myelofibrosis in survivors of atomic bomb at, 18: 19568
tumor incidence in populations of, 18: 19596

HISTAMINE
radioprotective effects of, mechanism for, 18: 19771
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)

HISTIDINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)

HOLMIUM
content and relative abundances in terrestrial materials, 18: 20202
separation by anion exchange in EDTA, effects of temperature on, 18: 20110

HOLMIUM ISOTOPES Ho-155
electron conversion spectra, 18: 21175 (JINR-P-1479(p.26-34))
HOLMIUM ISOTOPES Ho-165
energy level at 429 kev (½+), observations of, 18: 21162 (CONF-481-3)
HOMOGENEOUS REACTORS
control of power level of suspension, by electrolyte addition, 18: 21582(P)
HUTTONITES
alpha activity and thorium concentration in, in Conway granite, 18: 20222
HYDRAULICS
statistical mechanics of moderately dense fluids in, theory of irreversible, 18: 20633 (TID-20512)
HYDRAZINE, PHENYL-
protective effects against active radiation sickness, 18: 19804
HYDRIDES
determination in Zircaloy-2 process tubes, metallographic, 18: 20518 (HW-74949)
HYDRIODIC ACID
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
HYDROBROMIC ACID
effects on radioinduced reactions of 1-bromobutane and tin, 18: 20450(R) (BMI-1661(Del.))
HBr–HCl, radiolysis of, effects of bromine on hydrogen yields in, 18: 20062
HYDROCARBONS
analysis for carbon-hydrogen ratio, radiometric, 18: 19904
radical anion formation in saturated, 18: 19837(R) (MIT-905-1)
radioinduced degradation in HNO_3–TBP solution, 18: 20100 (ORNL-3524)
radiolysis of, mechanism of hydrogen formation in, 18: 20057
HYDROCHLORIC ACID
radiolysis of, effects of bromine, chlorine, and ethylene on hydrogen yields in, 18: 20062
spectra of uranium tetrachloride in, absorption, 18: 19935 (TID-18814)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
HBr–HCl, radiolysis of, effects of bromine on hydrogen yields in, 18: 20062
HYDRODYNAMICS
bibliography on, 18: 20621 (AFCRL-62-1075)
of two-phase fluid flow, 18: 20182 (TID-7694(p.108-49))
tensor artificial viscosity for two-dimensional Lagrangian system, 18: 20635 (UCRL-7205-T)
HYDROFLUORIC ACID
solvent properties for plutonium dioxide, 18: 20459(T,R) (EURAEC-954)
HYDROGEN
bonding in metals and refractory oxides at 1000 to 1600°C, 18: 19981
burning in stellar red giants, 18: 20727
compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
crystal structure of solid, temperature effects on, 18: 20008
determination in hydrocarbons, radiometric, 18: 19904
diffusion coefficients in carbon tetrachloride, 18: 19963
dispersion in diffusion systems, quantum effects in, 18: 19961
effects on thermionic cell power output and work function, 18: 20871
eigenfunctions for molecular, modified Schroedinger and symmetrized ordinary Schroedinger, 18: 20743
electric discharge in, cathode secondary emission in, 18: 20136
electric discharge in, triggering mechanism for undervolted, 18: 20149
electric discharge in crossed fields, ions from, 18: 20155
electric discharge in, dissociation in, 18: 21466
electric discharge in, Hα line intensity in Townsend, 18: 21473
electric discharge in, ionization coefficients for, 18: 21477
electric discharge in, temperatures of, 18: 21481
electric discharge in, fully ionized plasma from, 18: 21496
electric discharge in, production and decay times of diffusion-controlled electrodeless, 18: 21509
electric discharge in single-turn coil, properties of r-f, 18: 21514
electric discharge in, helical structure in r-f, 18: 21516
electric discharge in, ohmic heating in transient, 18: 21522
electron beam interactions in plasma of, cathode space charge in, 18: 21453
electron scattering by atomic, wave functions for, 18: 20735
impurity effects in potassium-sodium reactor coolant, 18: 21661
ionization by electrons, threshold law for, 18: 20761
ionization by electron impact, calculation of cross section near threshold for, 18: 20779
magnetic quadrupole radiative transitions in, 18: 20751
neutron total cross sections at 2.77 Mev, 18: 21159 (CEA-2399)
pinch discharge in, electron density and temperature in theta, 18: 21526
pinch discharge in, Hα emission in theta, 18: 21528
pinch discharge in, electron densities in theta, 18: 21529
pinch discharge in, axial streams in Z, 18: 21531
pinch discharge in, electron density and energy in, 18: 21532
plasma of, electromagnetic wave propagation in cold, 18: 21381 (NASA-TN-D-2071)
plasma of, electromagnetic wave propagation in, 18: 21382 (NASA-TN-D-2273)
plasma of, stability of a-c positive column of, 18: 21412
polarizability of atomic, shock-tube measurement and calculation of electric, 18: 20774
pressure variations and thermal conductivity in arc column of, in magnetic fields, 18: 21483
reactions with boron chloride and fluoride in plasma, 18: 19932 (KY-453)
reactions with hydrogen atoms, excitation transfer in, 18: 20740
reactions with oxygen ions in ionosphere, thermal, 18: 21092
separation from potassium–sodium coolants by cold-trapping, 18: 21657
spectra in artificial aurora, 18: 21073
spectra in mixtures with deuterium, negative ions in afterglow, 18: 21093
spectra of, plasma density determination from, 18: 21369 (ATN-64(9233)-8)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
viscosity of molecular, at 20 and 30°C, 18: 19989
yields in radiolysis of liquid hydrocarbons, effects of iodine and methyl iodide on, 18: 20057
yields in radiolysis of aqueous solutions of propanol containing nitrous oxide, 18: 20058
yields in radiolysis of hydrobromic and hydrochloric acids, 18: 20062
HYDROGEN IONS
acceleration of negative, in cyclotrons, 18: 20692
decay of negative, in isochronous cyclotrons on the basis of Lorentz force, 18: 20698
electron inelastic scattering by molecular, 18: 20750
nuclear magnetic shielding constants for, 18: 21233
reaction with metals at 260 kev, uv radiation emission in, 18: 20781
reactions with tungsten surfaces, electron ejection by, 18: 20777
HYDROGEN ISOTOPES
fractionation in aqueous perchloric acid solution, 18: 19968
HYDROGEN PEROXIDES
chemical effects on photochemical production of amines, 18: 20081
radiolysis effects on hydroxyl radical yields in aqueous benzene, 18: 20047
reactions with nitrosylruthenium nitrato complexes in nitric acid solutions, 18: 19924 (AERE-R-4537)
yields in radiolysis of aqueous solutions of 2-propanol containing nitrous oxide, 18: 20058
HYDROGEN SYSTEMS
D–H, viscosity at 20 and 30°C, 18: 19989
HYDROMAGNETIC WAVES
motion in steady two-dimensional MHD flow, 18: 20630 (NYO-10436)
propagation along geomagnetic meridian in lower exosphere, 18: 21077
propagation in current-carrying plasma column with nonuniform mass density, 18: 21385 (NP-13863)
propagation in lower exosphere, short-period geomagnetic pulsations from, 18: 21076
propagation in nonisothermal plasma, 18: 21431
propagation in plasma, 18: 21422
propagation of Alfvén, in inhomogeneous magnetic fields, 18: 20651
stability in conducting fluids, 18: 20649
HYDROXYL IONS
density in lower ionosphere, 18: 21075
HYDROXYL RADICAL
yields in gamma radiolysis of aqueous benzene, effects of hydrogen peroxide and nitrous oxide on, 18: 20047

HYGROMETERS
properties of radiometric, in industry, 18: 20425
HYPERFINE STRUCTURE
determination of nuclear, method for, 18: 21164 (CONF-481-36)
splitting of, measurement of Stark-effect and Zeeman-effect, 18: 20762
theory of core-electron contributions to hyperfine interactions, 18: 20749
HYPERFRAGMENTS
binding energy in $_{\Lambda}H^{3}$ for nonlocal interaction, 18: 21182 (JINR-P-1579)
identification and properties, 18: 20895 (CERN-64-6)
nuclear emulsion techniques in study of, 18: 20966
production in lithium-loaded nuclear emulsions by 1.5-Bev/c mesons (K^-), 18: 20938
HYPERONS
interactions with nucleons, amplitudes for, 18: 20913 (TID-20483)
production in proton-antiproton collisions, unitary symmetry model for, 18: 20953
properties of Y*, 18: 20899 (CERN-64-6(p.71-98))
resonance models and symmetries of, octet and Sakata, 18: 20994
resonance states of, motion of Y_1^* pole in approach to degeneracy, 18: 21016
resonance states of, width of Y_1^*, 18: 21020
HYPERONS (Λ)
decay of, branching ratio for leptonic and nonleptonic, 18: 20973
interactions, 18: 20895 (CERN-64-6)
interactions with nucleons, π-K resonance in, 18: 21003
interactions with mesons (π), resonances in, 18: 21006
interactions with mesons (π) at low energies, analysis of, 18: 21009
interactions with mesons (π), motion of poles in resonance, 18: 21016
resonance models and symmetries of, octet and Sakata, 18: 20994
HYPERONS (Λ°)
spin-parity of, Adair determination of, 18: 20998
HYPERONS (Σ)
interactions with mesons (π), resonances in, 18: 21006
interactions with mesons (η) and (K), motion of poles in resonance, 18: 21016
resonance models and symmetries of, octet and Sakata, 18: 20994
HYPERONS (Σ^-)
decay of, branching ratio for leptonic and nonleptonic, 18: 20973
decay of, branching ratios of, 18: 21015
decay of, mesonic, 18: 20914 (TID-20488)
HYPERONS (Σ^+)
decay of, branching ratios of, 18: 21015
decay of, mesonic, 18: 20914 (TID-20488)
HYPERONS (Ξ)
interactions with mesons (K), motion of poles in resonances, 18: 21016
resonance models and asymmetries of, octet and Sakata, 18: 20994
HYPERONS (Ξ^-)
production in meson (K^-)-proton interactions at 1.80 and 1.95 Bev/c, 18: 20959
properties, 18: 20959
HYPERONS (Ξ^0)
mass, 18: 20959
HYPOCHLORITES
9-decalylcarbinyl, decomposition in carbon tetrachloride, 18: 19837(R) (MIT-905-1)

I

ICE
triton diffusion in, at 0 to −35°C, 18: 20963
IMMUNE REACTIONS
effects of cytotoxic agents on human, 18: 19523
of fetal thymus cell transplants in irradiated mice, 18: 19766
radiation effects on mouse, continuous gamma, 18: 19623
radiation effects on rabbit and rat, x, 18: 19722
radiation effects on rabbit, 18: 19735
radiation effects on rabbit smallpox, x, 18: 19737
IMMUNITY
radiation effects on mouse, effects of thymus on x, 18: 19546
radiation effects on mouse and rat influenza, x, 18: 19557(T) (JPRS-23956(p.18-26))
radiation effects on dog, whole body, 18: 19603
radiation effects on virus disease, review, 18: 19747
radiation effects on rabbit, restoration effects of immune donor nucleoproteins on, x, 18: 19765
IN-PILE LOOPS
connector testing for ATR helium, 18: 21681 (HW-80680)
development of dynamic corrosion and chemical control, 18: 21565 (IDO-16812)
INCONEL
compatibility with thorium and uranium borides and carbides, 18: 20450(R) (BMI-1661(Del.))
corrosion by superheated steam, 18: 21668(R) (GEMP-274)
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)
INCONEL X
corrosion by superheated steam, 18: 21668(R) (GEMP-274)
INDEXES
for reports on developments in engineering, fabrication, and field support of laboratory programs, 18: 21716(R) (ORNL-TM-794)
on developments in support of laboratory programs, 18: 21715(R) (ORNL-TM-791)
INDIAN OCEAN
cesium content in, comparison of Atlantic and Pacific Oceans with, 18: 20220
INDIUM
alloying effects on corrosion of aluminum–magnesium alloys, magnesium, and magnesium–zinc alloys, 18: 20482
determination by chelating radiometric titration using EDTA, 18: 19899
effects on superconductivity of niobium–tin alloys, 18: 21110
separation from chloride solutions by solvent extraction using tridodecylaminehydrochlorides, 18: 19837(R) (MIT-905-1)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
INDIUM ALLOYS
Cu–In, phase transitions in, oscillation damping in, 18: 20560
INDIUM ISOTOPES In-110
beta decay scheme and gamma spectra, 18: 21355
INDIUM ISOTOPES In-114
conversion electron spectra of isomeric, 18: 21313
conversion-electron spectra, 18: 20360
INDIUM ISOTOPES In-115
energy levels, 18: 21289
INDIUM ISOTOPES In-117
energy levels, 18: 19837(R) (MIT-905-1)
INDOLE,3-(2-AMINOETHYL)-
preparation by photochemical reduction of tryptophan, 18: 20081
radiation effects on content and metabolism in rats, 18: 19652
INDOLEACETIC ACID, 5-HYDROXY-
radiation effects on urinary excretion of, by rats, 18: 19626
radiation effects on urinary excretion by rats, effects of cystamine on, 18: 19639
5-INDOLOL, 3-(2-AMINOETHYL)-
protective effects against hemorrhage syndrome in radiation sickness, 18: 19696
protective effects against radioinduced sterility in mice, 18: 19711
radiation effects on content and metabolism of, in rats, 18: 19652
radioprotective effects of, mechanism for, 18: 19771
INDUSTRIAL MANAGEMENT
performance evaluation system for machining personnel, 18: 21731 (Y-1461)
quality survey, vendor attitude toward, 18: 21718 (SC-R-64-135)
reduction of human errors in man-machine systems, 18: 21719 (SC-R-748)
INFECTIONS
hookworm, effects on intestinal absorption of nutrients in man, 18: 21724(R) (TID-20404)
INFRARED RADIATION
pathological effects on rabbit eyes, 18: 19547(R) (AMRL-TDR-63-71)
INITIAL ENGINE TEST
control characteristics, 18: 21561 (APEX-603(Del.))
INOR-8
corrosion by superheated steam, 18: 21668(R) (GEMP-274)
INOSITOL
labeling with tritium by Wilzbach method, position in myoinositol, 18: 20073

phospholipids, effects on blood coagulation, 18: 19535
INSECTICIDES
synthesis of phosphorus-32-labeled, 18: 20024
INSECTS
radiation and temperature effects on hatching of eggs of, ultraviolet, 18: 19759
radiation effects on germ cell cytochemistry in, x, 18: 19615
radiosensitivity sites in embryos of Tribolium, use of linear accelerators for finding, 18: 19668
INSTRUMENTATION
errors and signal-to-noise ratio of binary cross-correlation measurements of system impulse response, 18: 20278 (AEEW-R-329)
transistors in, field-effect, 18: 20279 (BNL-7867)
INSTRUMENTS
design of spacecraft information, 18: 20412
INSULIN
effects of, on oxygen consumption in irradiated rats, 18: 19806
effects on uptake of labeled amino acid by isolated intact rat diaphragm, 18: 19540
INTERFEROMETERS
design for study of magnetic phase shift of electron waves, 18: 20318
use for gas discharge temperature measurements, 18: 21481
use in plasma diagnostics, 18: 21512
INTESTINE
effects of hookworm infection on nutrient absorption by, in man, 18: 21724(R) (TID-20404)
radiation effects on DNA in rat, small, 18: 19682
radiation effects on albumen, DNA, and RNA synthesis in, 18: 19688
radiation effects on mitotic changes in epithelium of, 18: 19689
radiation effects on extracellular space in, 18: 19718
radiation effects on mucosal iron-59 uptake by rat, protective effects of MEA against, x, 18: 19787
INULIN
radiation effects on diffusion in intestinal wall, 18: 19718
INULIN SPACE
radiation effects on, in rats, 18: 19718
IODINE
content in marine atmosphere, 18: 19837(R) (MIT-905-1)
determination of organically bound, activation, 18: 19877
effects on hydrogen yields in radiolysis of liquid hydrocarbons, 18: 20057
electric discharge in, constriction in glow, 18: 21462
isotopic exchange with *o*-iodoanisole, effects of butoxide, chloride, and tin ions on, 18: 19964
IODINE CHLORIDES
graphite–ICl, boundary dislocations in interlamellar compounds of, electron microscopic studies of, 18: 19931 (EUR-542.e)
IODINE ISOTOPES
neutron emission by, delayed, 18: 21221
IODINE ISOTOPES I-127
energy levels, 18: 21231
IODINE ISOTOPES I-128
reactions of recoil, with hydrocarbons and halogenated hydrocarbons, 18: 20041 (MMPP-167-6)
IODINE ISOTOPES I-129
beta decay in meteorites, 18: 20726
energy level at 26.8 kev, lifetime of, 18: 21238
energy levels, 18: 21285
use as nonradioactive tracer, 18: 19837(R) (MIT-905-1)
IODINE ISOTOPES I-131
beta spectra of, Fermi plots of, 18: 20360
content in atmosphere from fossil-fuel power plants, 18: 20265
content in fresh green vegetables in Germany, fall 1962, 18: 19810
content in milk in England, 18: 20208 (AERE-R-4415)
content in milk in German Federal Republic, Sept. 1961 to Sept. 1962, 18: 19809
effects on protometabolism in calcified tissues, 18: 19679
energy levels, 18: 21231
production of pure, from tellurium, 18: 20436(P)
radiodiagnosis using, dosage and uptake measurements in, 18: 19822
secretion in thyroidectomized guinea pigs, ether and pilocarpine effects on, 18: 19528
IODINE ISOTOPES I-132
radiodiagnosis using, dosage and uptake measurements in, 18: 19822
ION BEAMS
production of high-current low-divergence, 18: 20741
stabilization of, equipment for, 18: 20757
ION EXCHANGE MATERIALS
preparation and properties of granular potassium cobalt ferrocyanide for cesium sorption, 18: 20097 (CONF-179-1)
preparation and properties of organic arsenic- or phosphorus-containing, review, 18: 19838 (UJV-909/63)
self-exchange in chelating, 18: 19972
use in chromatographic separations, review on, 18: 19857
ION EXCHANGE PROCESSES
developments in, review of, 18: 19859
ION PUMPS
magnetic field design for large, 18: 20158
ION SOURCES
arc properties in whirl-stabilized d-c, 18: 20662
design for 1-Mev accelerator, 18: 20691
design of pulsed, for tritium ions, 18: 20654
development of high-current low-divergence, 18: 20741
development of hydrogen discharge as, 18: 20155
development of Penning discharge as, 18: 20154
performance of porous tungsten with electrostatic Pierce accelerator, 18: 20289
IONIZATION
conference on, in gases, 18: 20671
of atoms and ions by electrons, cross sections for, 18: 20768
of cesium and hydrogen by electron impact, calculation of cross sections near threshold for, 18: 20779
pressure, for high-Z material, 18: 20636 (UCRL-7286-T(Pt.2))
theory of electron-impact, threshold law in, 18: 20761
IONIZATION CHAMBERS
development and testing of high-temperature gamma-compensated a-c, 18: 21564(R) (GEMP-81)
development for low-energy environmental monitoring, 18: 20341 (TID-20564)
development of extrapolation-type, for electrons and gamma radiation, 18: 20394
development of gridded, 18: 20134(R) (ORNL-TM-792)
energy resolution for alpha particles, 18: 20393
particle tracks in, device for measuring, 18: 20396
performance for fission fragment angular and energy distributions, 18: 20392
performance for in-core measurement of reactor neutron flux, effects of gamma radiation on, 18: 21563(R) (GEAP-4483)
primary standard x ray, absolute measurement in, 18: 19826
semiconductor-filled, high-energy particle spectrometry using, 18: 20410
use in border ray r-unit absolute measurements, 18: 19825
IONOSPHERE
charge rearrangement and recombination in D- and E-regions in, calculation, 18: 21094
charged-particle production in, thermal reactions of, 18: 21092
electrodynamics of, 18: 21078
electromagnetic wave reflection from, at very long wavelengths, 18: 21441
electron heating in, sources for, 18: 21084
ion kinetics in lower, 18: 21075
IONS
acceleration of heavy, design of tandem generator for, 18: 20699
diffusion of plasma, across magnetic field, 18: 21388 (TID-20491)
effects of heavy, on cells and macromolecules, 18: 19571
effects of water movement on movement of, into tomato root xylem, 18: 21723 (TID-18877)
electron shell order in atomic, 18: 20758
emission by cathodes, secondary, 18: 20136
interactions with electric fields, power generation by, 18: 20833 (GA/PHYS/63-11, 12)
mass spectra of excess-kinetic-energy, in organic compounds, 18: 20026
migrations in countercurrent electrolytic separation processes, mass

effects on, 18: 20112
motion in arc discharge, forward and retrograde, 18: 20144
motion in arc discharges in transverse magnetic fields, 18: 21488
nuclear magnetic shielding constants for 2-, 3-, and 4-electron, 18: 21233
production in Penning discharge, 18: 20154
reactions with atoms, resonance charge exchange in, 18: 20769
reactions with electrodes, charged-particle emission in, 18: 20665
reactions with molecules, use of mass spectrometer in studies of, 18: 21703 (CONF-296-4)
temperatures in plasma, method for measuring, 18: 21384 (NP-13853)
transport in plasma, 18: 21439

IRIDIUM
corrosion by cesium at 750°C, 18: 20873
performance compatibility with thermionic cell fission heat source, 18: 20874
reflectance of crystalline, 18: 19837(R) (MIT-905-1)

IRIDIUM ALLOYS
Ir–Rh–Ti, superconductivity, 18: 21112

IRON
analysis for oxygen, activation, 18: 19886
analysis for silicon, activation, 18: 20425
analysis of high-purity, activation, 18: 19876
analysis of oxidized surfaces of, for arsenic, activation, 18: 19903
chronopotentiometry and voltammetry of, in liquid fluorides, 18: 19966
corrosion by cesium at 750°C, 18: 20873
cosmic-ray reactions with, in stony meteorites, production of helium-3 and neon-21 by, 18: 20204
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in molybdenum, tungsten, and their alloys, classical methods for, 18: 19921
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
diffusion in zirconium, temperature dependence of, 18: 20561
effects on luminescence of zinc sulfide phosphors, 18: 20003
ionization of, pressure, 18: 20636 (UCRL-7286-T(Pt.2))
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
separation from chloride solutions by solvent extraction using tridodecylaminehydrochlorides, 18: 19837(R) (MIT-905-1)
separation from plutonium by precipitation with ferric hydroxide, 18: 19915
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
shielding properties, 18: 21543 (BMI-1384)

IRON ALLOYS
corrosion by superheated steam, 18: 21698(R) (ANL-6860)
Er–Fe, erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
Er–Mn–Fe, erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
Fe–Ni, corrosion by cesium at 750°C, 18: 20873
Fe–Pu, separation of plutonium from, by electrorefining, 18: 20099 (LA-3029)
Fe–Rh–Ti, superconductivity, 18: 21112

IRON(III) CHLORIDES
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
graphite–$FeCl_3$, boundary dislocations in interlamellar compounds of, electron microscope studies of, 18: 19931 (EUR-542.e)

IRON CYANIDES
effects on cesium-137 uptake by rats, 18: 19534

IRON(III) HYDROXIDES
reactions with plutonium, precipitation, 18: 19915
sorptive properties for fission products, 18: 20102 (UJV-850/63)

IRON ISOTOPES Fe-54
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291

IRON ISOTOPES Fe-55
electron-capture decay of, energy spectrum of orbital electrons ejected in, 18: 21347
energy levels from (p,d) reactions, spins of, 18: 21299

IRON ISOTOPES Fe-56
deuteron reactions (d,t) at 14.7 Mev, spin dependence of angular distributions from, 18: 21301
helium-3 reactions (He^3,α) with, analysis of, 18: 21204 (LADC-6302)
neutron scattering at 1.2 Mev, cross section for excitation of 0.84-Mev level in, 18: 21217
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
proton reactions (p,d) at 28 Mev, angular dependence on final state spin in, 18: 21299

IRON ISOTOPES Fe-57
energy levels from (p,d) reactions, spins of, 18: 21299
nuclear magnetic resonance in iron nitrides, hyperfine fields and moments from, 18: 19979
nuclear resonance absorption in zinc sulfide phosphors, 18: 20003
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291

IRON ISOTOPES Fe-58
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
proton reactions (p,d) at 28 Mev, angular dependence on final state spin in, 18: 21299

IRON ISOTOPES Fe-59
beta decay of, circular polarization of gamma radiation following, 18: 21309
incorporation in erythrocytes of irradiated guinea pig, effects of postirradiation bleeding on, 18: 19717
radiation effects on mouse splenic uptake of, x, 18: 19594
radiation effects on rat mucosal uptake of, protective effects of MEA against, x, 18: 19787

IRON NITRIDES
iron-57 NMR in, hyperfine fields and moments from, 18: 19979

IRON SULFIDES
neutron magnetic inelastic scattering by pyrrhotite crystal, 18: 21131 (PAN-279)

IRON SYSTEMS
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
Fe–UN, composition of cermet of, for use as reactor fuel, 18: 20465(P)

IRRADIATION FACILITIES
cobalt-60 gamma ray, design of, featuring air induction, 18: 20419

IRRADIATION TECHNIQUES
extracorporeal, for blood, use in studies on lymphocytes, 18: 19548 (BNL-7926)
for extracorporeal blood exposure, 18: 19504 (BNL-7839)

IRRADIATIONS
radiation intensity distributions in square and circular fields for, effects of geometrical penumbra on, 18: 19833

ISOTOPE EFFECTS
determination by calculation of vibration frequencies of molecular and transitional states, 18: 19951
determination by calculation of vibrational frequencies of transition states, 18: 19952
on zirconium spectra, 18: 20002
quantum, in permeation, 18: 19961

ISOTOPE SEPARATION METHODS
electromagnetic, performance of, 18: 20432
use of short countercurrent columns for, 18: 20433

ISOTOPES
book: *Progress in Isotope Geology*, 18: 20207
production and recovery from nuclear explosions in salt, 18: 20121 (CONF-470-1)

production of heavy, by nuclear explosions, 18: 20126 (UCRL-7770)
ISOTOPIC EQUILIBRATION
developments in, review of, 18: 19867
substoichiometric method for trace metals, 18: 19852 (UJV-992/63)
use in measuring human aldosterone secretion rate, 18: 19543
ISRAEL
nuclear energy needs and prospects in, 18: 21739

J

JAPAN
fallout monitoring, 1962 and 1963, 18: 20232 (JAERI-1057)
lead ores of, isotopic composition of, 18: 20226 (INSJ-67)
polonium-210 levels in urine of uranium miners in, 18: 19916
JEEP REACTOR
operation, Oct.-Dec. 1963, 18: 21706(R) (KR-66)
JEEP REACTOR-II
development, Oct.-Dec. 1963, 18: 21706(R) (KR-66)
JOINTS
testing connectors for pressurized helium loop, 18: 21681 (HW-80680)
JOURNAL BEARINGS
design and performance of gas-lubricated self-acting pivoted-pad, 18: 20135(R) (TID-20448)
testing of liquid-potassium, for SPUR turbogenerator, 18: 21666 (APL-TDR-64-27)

K

KEROSENE
kerosene–HNO_3–TBP, degradation and cleanup, 18: 20100 (ORNL-3524)
KETONES
phenyl alkyl, mass spectra in photolysis and radiolysis of, 18: 20063
KIDNEYS
damage to, in uranium miners, 18: 20271
photoscanning of, after injection of technetium-99m as pertechnetate, 18: 19814 (CONF-453-1)
radiation effects on parotitis virus reproduction in guinea pig and mouse, x, 18: 19556(T) (JPRS-23956(p.9-17))
radiation effects on hamster, x, 18: 19672
radiation effects on B_{12} content of mouse, x, 18: 19743
radiation effects on proteolysis in rat, gamma, 18: 19745
radiation effects on cells of human, methods for modification of, alpha, beta, deuteron, gamma, and x, 18: 19760
KRYPTON
effects on radiolysis of carbon monoxide, 18: 20087
electron multiple scattering at 40 to 130 kev, linear displacement distributions in, 18: 21316
electron scattering at 25 kev, cross sections for and optical transitions in, 18: 20764
ionization by electrons, cross sections for, 18: 20768
ionization by x radiation, K- and L-shell, 18: 20730 (CONF-481-7)
lithium-7 scattering at 7 to 60 kev, angular distributions from, 18: 21318
performance in low-voltage thermionic diodes, 18: 20851
separation from xenon by gas chromatography, 18: 21707(R) (MLM-1177)
sorption by graphite, surface area measurements by, 18: 19971
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
thermionic properties in diodes, 18: 20831 (APL-TDR-64-28)
KRYPTON IONS
ionization by monovalent, by electrons, cross sections for, 18: 20768
reactions with molecules at 15 to 200 ev, charge exchange in, 18: 20742
sputtering on copper at 100 to 600 ev, velocity distributions from, 18: 20788
sputtering on metals at 20 to 1000 ev, mass dependence of, 18: 20786
sputtering on metals at 10 to 2000 ev, energy spectra and yields from, 18: 20787
KRYPTON ISOTOPES
separation by thermal diffusion, 18: 21708(R) (MLM-1178)
separation by thermal diffusion, 18: 21709(R) (MLM-1179)
KRYPTON ISOTOPES Kr-84
content in chondrites, 18: 20726
KRYPTON ISOTOPES Kr-85
content in atmosphere from fossil-fuel power plants, 18: 20265
uptake by human brain during anesthesia, 18: 19522
KRYPTON SYSTEMS
Kr–O, radiolysis of, ozone formation, 18: 20095

L

LABORATORIES
gamma radioactivity of building materials for construction of low-background, 18: 20210 (CLOR-20)
LABORATORY EQUIPMENT
development, 18: 20134(R) (ORNL-TM-792)
LACTOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
LAMINATES
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
LANTHANUM
content and relative abundances in terrestrial materials, 18: 20202
determination as molybdate, amperometric, 18: 19901
determination in thorium using xylenol orange, spectrophotometric, 18: 19883
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from cerium using bis(2-ethylhexyl) phosphoric acid, chromatographic, 18: 20109
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
LANTHANUM ALLOYS
Gd–La, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
LANTHANUM BORIDES
thermodynamic properties of hexavalent, 18: 19928 (CONF-405-6)
LANTHANUM CHLORIDES
effects on blood coagulation, 18: 19535
LANTHANUM COMPLEXES
with arsenazo, composition of, 18: 19948
LANTHANUM FLUORIDES
solvent properties for neptunium, plutonium, and uranium, 18: 19896
LANTHANUM ISOTOPES La-139
gamma reactions (γ,n) up to 30 Mev, cross sections for, 18: 21278
LANTHANUM ISOTOPES La-140
beta decay of, cerium-140 levels from, 18: 21286
energy levels of, spins and parities of, 18: 21208 (NP-13841)
LANTHANUM ISOTOPES La-142
decay of isomeric, cerium-142 energy levels from, 18: 21270
LANTHANUM NITRATES
separation by solvent extraction using TBP, calculation of cascade stage-wise conditions for, 18: 20098 (IS-780)
solubility polytherms of systems with other ceric earths, 18: 20108
LANTHANUM OXIDES
analysis for oxygen, 18: 19907
CaO–La_2O_3–ZrO_2, phase studies, 18: 20538
LAVA
strontium-86/87 content in Hawaiian, 18: 20216
LEAD
effects on superconductivity of niobium–tin alloys, 18: 21110
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
electrodeposition on aluminum, 18: 20134(R) (ORNL-TM-792)
electron reactions in, bremsstrahlung and pair production in, 18: 21334
electron shower production in, at 100, 200, and 380 Mev, Monte Carlo calculations of, 18: 21322
electron-photon showers in, bubble chamber measurements of, 18: 20669
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359

neutron attenuation by, from 14-Mev source, 18: 19821
performance as reactor coolant, evaluation of, 18: 20192
photon shower production in, at 100, 200, and 380 Mev, Monte Carlo calculations of, 18: 21322
proton reactions (p,n) at 6 Bev, 18: 21698(R) (ANL-6860)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
shielding properties, 18: 21543 (BMI-1384)
superconductivity of, surface, 18: 21101
use in radiation protection pastes for skin in radiotherapy, 18: 19832

LEAD ALLOYS
Bi–Pb, physical properties of liquid eutectic, review, 18: 20516 (EUR-599.d)
Bi–Pb, superconductivity of, surface, 18: 21101
Pb–Th, separation of uranium from solid intermetallic compounds of, 18: 20118(P)

LEAD CHLORIDES
$PbCl_2$–KCl, radioinduced Cl_2^- molecule-ion centers in, bleaching of, 18: 20038 (COO-1044-13)

LEAD COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946

LEAD GLASS
radiation and heating effects on flint-, gamma, 18: 20586

LEAD ISOTOPES
abundances in mine samples from Sudbury, Ontario, gas source mass spectrometry of, 18: 20203

LEAD ISOTOPES Pb-199
half life, 18: 21258

LEAD ISOTOPES Pb-202
nuclear pairing model of, exact eigenstates of pairing-force Hamiltonian for, 18: 21239

LEAD ISOTOPES Pb-204
nuclear pairing model of, exact eigenstates of pairing-force Hamiltonian for, 18: 21239

LEAD ISOTOPES Pb-206
content in natural lead, 18: 20430
nuclear pairing model of, exact eigenstates of pairing-force Hamiltonian for, 18: 21239

LEAD ISOTOPES Pb-207
content in natural lead, 18: 20430

LEAD ISOTOPES Pb-208
content in natural lead, 18: 20430
nucleon binding energies, energy levels, and potentials for, 18: 21358

LEAD ISOTOPES Pb-210
content in human bones and teeth, 18: 19532

LEAD ISOTOPES Pb-211
half life, 18: 21709(R) (MLM-1179)

LEAD ISOTOPES Pb-212
conversion electron spectra, 18: 21313
determination in man by whole-body counting after Thorotrast injection, 18: 20340(R) (TID-20525)

LEAD NIOBATES
luminescence of, self-activated, 18: 20060

LEAD ORES
isotopic composition of, on Honshu Island, Japan, 18: 20226 (INSJ-67)

LEAD TANTALATES
luminescence of, self-activated, 18: 20060

LECTURES
on uses of thermal neutrons in nuclear physics, 18: 21185 (KR-64)

LEPTONS
classification in SU(4), 18: 20931
magnetic moment of, effects of charged intermediate vector boson on anomalous, 18: 20982
Regge poles in perturbation theory for weak interactions, 18: 20997

LEUCINE
leucine-pyridoxal, deuterium exchange in, 18: 20027

LEUKEMIA
development in rats after uv-inactivated virus injection, 18: 19614
incidence of, in Hiroshima and Nagasaki, 18: 19581
radiation effects on blood cells in chronic, beta, 18: 19789
radioinduced in black mice, resistance to, 18: 19663
radioinduced in man, 18: 19579
radioinduced in mice, virus effects on x, 18: 19578
radioinduced in mice, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and bone marrow against, x, 18: 19796
radioinduced in New England, background, 18: 20214
radioinduced myeloid, in mice, physical factors affecting gamma, fast neutron, x, 18: 19577

LEUKOCYTES
proliferation kinetics and regulation, 18: 19504
protective effects of transfusions of, against gamma irradiation in guinea pigs, 18: 19776
radiation effects on lipid metabolism in human, 18: 19552(R) (NYO-2769-1)
radiation effects on dog, 50- *vs.* 250-kvp x, 18: 19585
radiation effects on distribution of rabbit, gamma, 18: 19697
radiation effects on glycogen in mouse, x, 18: 19734
radiation effects on phagocytosis of rabbit, x, 18: 19736
radiation effects on glycogen content of mouse spleen, when used with antigens, x, 18: 19741
radiotoxins released by, 18: 19653

LEVEL REGULATORS
design of radiometric, 18: 20324(P)

LIBRARIES
cross sections for reactor analysis, testing of, 18: 21551 (GEMP-283)
data in Winfrith neutron cross section, 18: 21156 (AEEW-R-351)

LIFE SPANS
effects of radium exposure on, of man, 18: 19551 (NYO-2762)
radiation effects on, of Drosophila, 18: 19554 (TID-20550)
radiation effects on hamster, x, 18: 19672
radiation effects on mouse, protective effects of 2-(2-aminoethyl)-2-thiopseudourea AET and bone marrow against, x, 18: 19796

LIGHT
effects on electric conductivity of semiconductors, device for measuring, 18: 20307
pathological effects of, on rabbit eyes, 18: 19547(R) (AMRL-TDR-63-71)
scattering by dilute polymer solutions, 18: 20627(R) (NP-13815)

LIGHT SOURCES
design for optical systems, 18: 21717 (SC-R-64-119)

LIGROINE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066

LIMBS
radiation effects on circulatory system of mouse, x, 18: 19640

LINEAR ACCELERATORS
electrons from, used for mycosis fungoides therapy, 18: 19820
magnets for proton, design of quadrupole focusing, 18: 20681 (TID-20457)
oscillation power balance equations for, 18: 20683
use in finding sensitive sites in Tribolium embryos, 18: 19668

LIPIDS
radiation effects on metabolism of, in human bone marrow and leukocytes, 18: 19552(R) (NYO-2769-1)
radiation effects on rabbit, x, 18: 19561
radiation effects on activity of, in adrenal glands of guinea pigs, 18: 19710
radiation effects on mouse blood cell metabolism of, x, 18: 19730

LIQUID METAL COOLED REACTORS
components test loop for ASCR, 18: 21570 (NAA-SR-Memo-8217)
coolant burnout problems in sodium, 18: 20193
coolant performance in, reliability of sodium, 18: 20194
coolant removal from upper plenum of 200-Mw(e) SGR, hydraulics of, 18: 21639 (NAA-SR-Memo-9241)
coolants for, evaluation of, 18: 20192
cooling system for, design of mixing tees for, 18: 21567 (NAA-SR-Memo-7485)
core hydraulic and thermal analyses for 1000-Mw(e) SGR alternate fuel, 18: 21616 (NAA-SR-Memo-9569)
fuel channel variable orifice design for Advanced Sodium Cooled Reactor, 18: 21568 (NAA-SR-Memo-8079)
fuel element development for Advanced Sodium Cooled Reactor, 18: 21614 (NAA-SR-Memo-8017)
fuel element grapple and hold-down-latch development for SGR, 18: 21638 (NAA-SR-Memo-8266)
lattice parameters versus pitch for ASCR closed lattices, 15-group

diffusion study of, 18: 21600 (NAA-SR-Memo-9489)
material bucklings of ASCR, 18: 21599 (NAA-SR-Memo-9382)
stability in design of, thermal, 18: 20187
status of sodium, 18: 20464
vibration analysis of large SGR fuel element and process channel, 18: 21615 (NAA-SR-Memo-9164)

LIQUIDS
magnetohydromagnetic theory of planar traveling waves on free surface of inviscid, 18: 21445
sampling of radioactive, system for, 18: 20134(R) (ORNL-TM-792)
thermal capacity and compressibility of, calculation, 18: 19929 (CONF-417-20)
gas–liquid, phase and velocity distribution measurements in two-phase flow, 18: 20163 (EURAEC-952)

LISBON ANTICLINE (UTAH)
geology of mineralogical changes in uranium deposit sediments in, 18: 20228

LISBON VALLEY AREA (COLO.-UTAH)
geology of mineralogical changes in uranium deposit sediments in, 18: 20228
uranium emplacement in, mechanism of, 18: 20228

LITHIUM
additive effects in silicon surface-barrier radiation detectors, 18: 20355
corrosive effects of liquid, 18: 21698(R) (ANL-6860)
determination in minerals and rocks, spectroscopic, 18: 19853(T) (CEA-tr-R-1711)
electron energy level quenching by magnetic field, metastable $(1s2s2p)\,^4P_{5/2}$, 18: 20627(R) (NP-13815)
electron structure, 18: 20548
nuclear magnetic shielding constants for, 18: 21233
performance as reactor coolant, evaluation of, 18: 20192
pump development for liquid, 18: 20131 (NAA-SR-Memo-2368(Rev.))
spectra in artificial aurora, 18: 21073

LITHIUM ALLOYS
separation of tritium from irradiated, 18: 20431
$BiLi_3$, formation in liquid lithium chloride–lithium fluoride eutectic, 18: 19978

LITHIUM CHLORIDES
electric conductivity of lithium-7-labeled, in dioxane–water mixtures, 18: 19976
Bi–LiCl–KCl, chemical state and distribution coefficient of copper in, 18: 19983
LiCl–LiF, formation of Li_3Bi in liquid, 18: 19978

LITHIUM FLUORIDES
fission recoil effects on crystals of, 18: 20450(R) (BMI-1661(Del.))
lithium-7 nuclear magnetic resonance line narrowing in, at 25 to 550°C, 18: 19991
BeF_2–LiF, chronopotentiometry and voltammetry of iron in liquid, 18: 19966
BeF_2–LiF–UF_4–ZrF_4, analysis for chromium by amperiometric titration, 18: 19869
LiCl–LiF, formation of Li_3Bi in liquid, 18: 19978
LiF–KF–NaF, chronopotentiometry and voltammetry of iron in liquid, 18: 19966

LITHIUM HYDRIDES
magnetic shielding and susceptibility of diatomic, 18: 19958
shielding properties, 18: 21543 (BMI-1384)
LiH–W, shielding properties, 18: 21676 (SSD-TDR-63-217)

LITHIUM IONS
electron energy level fine structure of, $2^1P_{0,1,2}$, 18: 20627(R) (NP-13815)
nuclear magnetic shielding constants for, 18: 21233
scattering by rare gases, theory of, 18: 20763
scattering by rare gas atoms at 7 to 60 kev, angular distributions from, 18: 21318
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)

LITHIUM ISOTOPES
separation factor of, in ion exchange using polystyrene exchange solution, 18: 20434

LITHIUM ISOTOPES Li-5
nuclear deformation parameters and energy levels for, 18: 21307

LITHIUM ISOTOPES Li-6
energy levels of, calculation from nucleon interactions, 18: 21345
neutron elastic and inelastic scattering at 14 Mev, 18: 21263
nuclear deformation parameters and energy levels for, 18: 21307
reactions (Li^6,α) with carbon-13 at 3.4 to 4.0 Mev, differential cross sections for, 18: 21295

LITHIUM ISOTOPES Li-7
hyperfine structure of $2^2P_{1/2}$ level of, 18: 21226
lithium-7 reactions (Li^7,α) at 2.30 to 3.77 Mev, differential cross sections for, 18: 21283
neutron elastic and inelastic scattering at 14 Mev, 18: 21263
nuclear deformation parameters and energy levels for, 18: 21307
nuclear magnetic resonance-line narrowing, 18: 19991
proton reactions (p,n) with, threshold energy for, 18: 21284
reactions (Li^7,α) with lithium-7 at 2.30 to 3.77 Mev, differential cross sections for, 18: 21283
scattering by rare gases, theory of, 18: 20763
scattering by rare gas atoms at 7 to 60 kev, angular distributions from, 18: 21318

LITHIUM ISOTOPES Li-8
beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
beta decay of, beta-alpha angular correlations in, 18: 21306
nuclear deformation parameters and energy levels for, 18: 21307

LITHIUM NITRATES
effects on separation of nitric acid from aqueous solutions by solvent extraction using long-chain amines, 18: 20107
$LiNO_3$–KNO_3, effects on chloride association with silver, 18: 19975

LIVER
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)
photoscanning of, after injection of technetium-99m as pertechnetate, 18: 19814 (CONF-453-1)
radiation effects on zinc-65 metabolism in mouse, x, 18: 19531
radiation effects on lysosomes of rat, from plutonium-239, 18: 19669
radiation effects on hippuric acid synthesis in rat, effects of glycine on, 18: 19631
radiation effects on bilirubin conjugation and excretion in rat, 18: 19632
radiation effects on phosphonucleoside content of rat, 18: 19702
radiation effects on extracellular space in, 18: 19718
radiation effects on functions of, in radiotherapy, protective effects of phospholipids against, 18: 19720
radiation effects on B_{12} content of mouse, x, 18: 19743
radioinduced degeneration in rats, effects of irradiated bone marrow on x, 18: 19790
radiotoxins released by, 18: 19653

LIVER DISEASES
diagnosis of, by scanning after the administration of molybdenum-99, 18: 19834

LUBRICANTS
analysis of, computer routine for neutron activation, 18: 19918
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
radiation effects on solid, fast neutron, 18: 20585 (WANL-TNR-109)

LUMINESCENCE
radioinduced, analysis of relaxation processes in, 18: 20078

LUNG DISEASES
incidence among uranium millers and miners, 18: 20256
radioinduced pneumonitis after lymphosarcoma therapy, x, 18: 19566

LUNGS
radiation effects on parotitis virus reproduction in guinea pig and mouse, x, 18: 19556(T) (JPRS-23956(p.9-17))
radiation effects on enzymes of guinea pig, x, 18: 19675
radiation effects on extracellular space in, 18: 19718
radioinduced fibrosis of, 18: 19694

LUTETIUM
content and relative abundances in terrestrial materials, 18: 20202
separation by anion exchange in EDTA, effects of temperature on, 18: 20110

LYMPH CELLS
production and function of, use of extracorporeal irradiation of blood in studies of, 18: 19548 (BNL-7926)

proliferation kinetics and regulation, 18: 19504 (BNL-7839)
radiation effects on rat thymic, 18: 19674
LYMPH SYSTEM
bismuth-206 and silver-111 uptake by dog, effects on skin homografts, 18: 19605
irradiation of dog, using yttrium-90-labeled DTPA, 18: 19601
radiation and vaccination effects on mouse, x, 18: 19740
radiation effects on mouse, effects of thymus on x, 18: 19546
radiation effects in influenza-vaccinated animals on plasmacytic reaction in, x, 18: 19557(T) (JPRS-23956(p.18-26))
radiation effects on tumors of, assay methods for gamma, 18: 19671
radiation effects on deoxyribopolynucleotide content in mouse, 18: 19630
radiation effects on human, x, 18: 19604
LYSINES
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
LYXOSE
oxidation by bromine, tritium isotope effects in, 18: 20031

M

MACHINING
performance evaluation system for personnel, 18: 21731 (Y-1461)
MAGNESIUM
corrosion of, effects of cobalt and gallium on, 18: 20482
cosmic-ray reactions with, in stony meteorites, production of helium-3 and neon-21 by, 18: 20204
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
performance as reactor coolant, evaluation of, 18: 20192
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
surface binding of, by marine bacteria, 18: 19520(R) (TID-20499)
MAGNESIUM ALLOYS
Al–Mg, corrosion of, effects of indium on, 18: 20482
Mg–Nd, corrosion of, effects of cobalt and gallium on, 18: 20482
Mg–Zn, corrosion of, effects of indium on, 18: 20482
MAGNESIUM CHLORIDES
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
MAGNESIUM COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946
MAGNESIUM ISOTOPES Mg-24
energy levels, 18: 21306
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
proton inelastic scattering at 10.3 Mev, 18: 21252
MAGNESIUM ISOTOPES Mg-25
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
MAGNESIUM ISOTOPES Mg-26
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
MAGNESIUM NIOBATES
luminescence of, self-activated, 18: 20060
MAGNESIUM OXIDES
dislocation loops in, electron microscopic determinations of, 18: 20546
radiation effects on strength of, fast neutron, 18: 20595
radiation effects on macroscopic growth of, neutron, 18: 20597
BeO–MgO, phase studies, 18: 20577
MAGNETIC FIELDS
charged-particle motion in axisymmetric, 18: 20645
cosmic-ray acceleration by magnetic pumping in, 18: 20823
cusped configuration of, asymptotic formulas for, 18: 21387 (NYO-10435)
design for large ion pumps, 18: 20158
effects on electric conductivity of semiconductors, device for measuring, 18: 20307
effects on spin orientation of spin-½ particles with pseudoscalar charge density, 18: 20946
effects on stability of Couette flow between rotating cylinders, 18: 20191
electric breakdown in crossed electric and, 18: 20153
electric discharge in crossed electric and, plasma rotation in, 18: 21501
electron beam focusing in symmetric growing, vertical, 18: 20704
electron temperature distributions in plasma in, 18: 21468
gas discharge in transverse, ion motion in, 18: 21488
hydromagnetic wave propagation in, inhomogeneous Alfvén, 18: 20651
interactions with expanding plasma cylinder, 18: 21427
measurement in space, U. S. program for, 18: 21090
of exploding galaxy M82, 18: 20718
particle trajectories in rapidly varying, 18: 21449
plasma containment in configurations with multipole stabilization, 18: 21414
plasma density fluctuations and rotation in longitudinal, 18: 21504
plasma diffusion across, 18: 21389 (TID-20509)
plasma discharge in, hysteresis in, 18: 21403
plasma electron energy and lifetime in radially increasing, increases in 18: 21499
plasma equilibrium in space-periodic, 18: 21434
plasma flow in axial, velocity of, 18: 21484
plasma flow in transverse, volocity of, 18: 21485
plasma jet motion in, 18: 21486
plasma jet motion in, in air, 18: 21487
plasma particle energy gains by reflection from r-f, 18: 21520
plasma particle orbits in d-c, 18: 21521
plasma pressure variations and thermal conductivity in, 18: 21483
plasma stability in strong, effects of conductivity on, 18: 21430
plasma stability in crossed electric and, 18: 21505
plasma wave propagation in weak, collisional damping of, 18: 21404
reduction of fringing, in particle-analyzing magnets, 18: 20644
sound wave propagation in, wavelength dependence in, 18: 20643
trapping in superconducting ring, 18: 21097 (UCRL-7308-T)
MAGNETIC MIRROR MACHINES
charged-particle injection into, longitudinal, 18: 21370 (CEA-R-2410)
plasma stability in, kinetic theory of flute, 18: 21371 (CLM-R-33)
MAGNETIC MIRRORS
particle trajectories in rapidly varying, 18: 21449
plasma deformation and drift from inhomogeneity in, 18: 21402
MAGNETIC MOMENTS
dipole, dissipation in 2-level systems, 18: 21046
transition probability for multipoles, $\Delta S = \pm 1$, 18: 20751
MAGNETIC MONOPOLES
existence of parity-violating, 18: 21062
MAGNETIC RECORDING SYSTEMS
for two modes of pulse recording on tape, 18: 20276 (AAEC/TM-227)
MAGNETIC RESONANCE
spectrometer for irradiating wet biological systems, 18: 20293
MAGNETOHYDRODYNAMIC CELLS
constant Mach number duct equations for, method of integrating, 18: 20839
design and development of self-excited, 18: 20835(R) (NP-13814)
design and operation of closed-loop, 18: 20830(R) (AD-432464)
design of a-c, 18: 20890(P)
design of nuclear, for a-c power production, 18: 20889(P)
development and testing, 18: 21698(R) (ANL-6860)
development of closed-cycle, 18: 20834(R) (NP-13803)
future potentials of power generation by, 18: 20838
plasma oscillations in, 18: 20840
power generation in, conditions for maximum, 18: 20836 (R61SD066)
vortex flow in arc heaters, 18: 21393
MAGNETOHYDRODYNAMICS
bibliography on, 18: 20621 (AFCRL-62-1075)
boundary layer on plane in anisotropic, 18: 20642
channel flow in presence of heat transfer in, effects of wall conductance on steady incompressible, 18: 21392
conducting flow in plane channels, 18: 20659
flow of conducting viscous fluid between parallel plates, 18: 20660
fluid flow in magnetic fields, equations for, 18: 20677
fluid flow past nonconducting walls in, 18: 20650
plasma characteristics in Hall propulsor, 18: 21391
plasma flow in channels, energy conversion with Hall currents in,

18: 21410
rotation of plasma in, 18: 21443
sphere rotation in conducting viscous fluid in, 18: 20664
theory of planar traveling waves on free surface of inviscid liquid, 18: 21445
wave motion in collision-free plasma, finite-amplitude compression, 18: 21386 (NYO-10434)
wave motion in steady two-dimensional flow, oblique shock and simple, 18: 20630 (NYO-10436)
MAGNETOMETERS
design of self-oscillating rubidium, for earth's field, 18: 20294
design of, for geomagnetic field intensity measurements, 18: 20288
MAGNETOSPHERE
electrodynamics of, 18: 21078
radiation effects on outer, solar corpuscular, 18: 20722
MAGNETS
design of focusing, for proton linear accelerator, 18: 20681 (TID-20457)
design of superconducting, 18: 21118
fabrication of superconducting, development of epoxy molding technique for, 18: 20134(R) (ORNL-TM-792)
field fringing in analyzing, reduction of, 18: 20644
refrigeration for cryogenic, 18: 21095(R) (NBS-8239)
MAGNOX ALLOYS
fabrication and properties as fuel element material, 18: 20463
radiation effects on fuel elements using, 18: 20463
MAIZE
effects of deuterium on root development in, 18: 19662
radiation effects on B^9 chromosome in TB-3a in, use of A-B translocations in mutation studies on, 18: 19513
radiosensitivity of hybrid forms of, 18: 19746
variations in, gametophyte dependence of, 18: 19507 (TID-20402)
MALONIC ACID
effects on ion-exchange separation of uranium from rare earths and thorium in aqueous media, 18: 20114
MALTOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
MAMMALS
biological effects of manganese in, 18: 21700 (BNL-7855)
carcinogenesis in, role of somatic mutations in, 18: 19505 (BNL-7912)
radiation effects on tumor cells of, 18: 19572
radiation injuries in, recovery from, 18: 19762
radiation response of organs and tissues in, proton, 18: 19812 (BNL-6966)
strontium-90 uptake by skeleton of, effects of diet on, 18: 19533
MAMMARY GLAND
cell generative cycle in neoplasms of mouse, 18: 21701 (BNL-7925)
MAN
alpha-emitters in bones and teeth of, 18: 19532
analysis for gamma radioactivity, whole-body, 18: 20337 (NYO-2553-1)
bone marrow viability in, poststorage techniques for preserving, 18: 19526
book: *Radiation Protection Practice. Part I. Fundamentals*, in German, 18: 20274
effect of hookworm infection on nutrient absorption by intestine of, 18: 21724(R) (TID-20404)
effects of radium exposure on life span of, 18: 19551 (NYO-2762)
human errors in man-machine systems, reduction of, 18: 21719 (SC-R-748)
hypertension induction in, effects of excess salt ingestion and genetic factors on, 18: 21702 (BNL-7971)
krypton-85 and nitrous oxide uptake by brain of, 18: 19522
ozone effects on x-irradiated erythrocytes in, 18: 19538
pathological effects of deposited radium in, 18: 19550 (NYO-2181-1)
radiation dosimetry of Thorotrast cases, 18: 20340(R) (TID-20525)
radiation effects on lipid metabolism in bone marrow and white blood cells in, 18: 19552(R) (NYO-2769-1)
radiation effects on fertility of, after accidental exposure, 18: 19648
radiation effects on oral membranes in, x, 18: 19624
radiation effects on populations of, low-dose, 18: 19625
radiation effects on hematological response in, homogeneous *vs.* in-homogeneous, 18: 19584
radiation effects on bone marrow repopulation in, x, 18: 19592
radiation effects on bone marrow cytology in, gamma and neutron, 18: 19602
radiation effects on, therapy for, 18: 19763
radiation effects on, protective effects of bone marrow transplants against, 18: 19764
radiation effects on, protective effects of bone marrow against, gamma, 18: 19769
radiation effects on cells nuclei in, relative γ and x, 18: 19685
radiation hazards to, from industrial exposure, 18: 19597
radioinduced chromosomal aberrations in, gamma and neutron, 18: 19582
radioinduced chromosomal abnormalities in, beta and x, 18: 19583
radioinduced dermatitis in, effects of irradiation on lymph vessels in, x, 18: 19604
radioinduced leukemia in, 18: 19579
response of, to sound from ultrasonic devices, 18: 21704 (HW-SA-3028)
strontium-90 metabolism kinetics in, 18: 20235 (NP-13868)
MANGANESE
biological effects in mammals, 18: 21700 (BNL-7855)
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
separation from protactinium by solvent extraction, 18: 20105
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
voltammetry in phosphoric acid–sulfuric acid or sulfuric acid using pyrolytic graphite electrode, 18: 19967
MANGANESE ALLOYS
Al–Mn–Th, phase studies of $ThAl_3$–$ThMn_2$, 18: 20554
Er–Mn–Fe, erbium-166 Mössbauer spectra in, hyperfine structure of, 18: 21272
Mn–Rh–Ti, superconductivity, 18: 21112
MANGANESE COMPLEXES
with chloride and sulfate ions in perchlorate solutions, paramagnetic resonance studies of, 18: 21730 (UCRL-10446)
MANGANESE ISOTOPES Mn-52
beta decay of, circular polarization of gamma radiation following, 18: 21309
MANGANESE ISOTOPES Mn-54
energy levels of, spins and parities of, 18: 21208 (NP-13841)
MANGANESE ISOTOPES Mn-55
nuclear magnetic resonance in manganese nitrides, hyperfine fields and moments from, 18: 19979
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
MANGANESE ISOTOPES Mn-56
beta decay of, circular polarization of gamma radiation following, 18: 21309
determination in organic reactor coolant, 18: 21553 (NAA-SR-Memo-7771)
MANGANESE NITRIDES
manganese-55 NMR in, hyperfine fields and moments from, 18: 19979
MANGANESE OXIDES
reactions with uranium dioxide, effects of halides on, 18: 19943
sorptive properties for protactinium, 18: 20105
MANGANESE SYSTEMS
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
MANNOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
MANOMETERS
design of magnetic-ionization-type, 18: 20198
MARCOULE REACTORS
environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)
MARITIME NUCLEAR STEAM GENERATOR
development of 630A, 18: 21668(R) (GEMP-274)
MARITIME REACTORS
design of Consolidated Nuclear Steam Generator II, 18: 21667 (BAW-1280)
MARTENSITES
crystallography, 18: 20537(T,R) (EURAEC-977)

MASERS
applications and theory of, conference on, 18: 20316
research progress on rubidium and ruby, 18: 20627(R) (NP-13815)
MASERS (OPTICAL)
applications and theory of, conference on, 18: 20316
engineering uses for cutting and welding, 18: 20120
radiation damage by Compton scattering of gamma and x rays used in pumping, 18: 20625 (N63-21469)
use for gas breakdown studies, 18: 21513
MASS SPECTROGRAPHY
background and optimum counting times for, counting statistics theory for variance in, 18: 19878
developments in, review of, 18: 19861
excess-kinetic-energy ions in organic mass spectra, 18: 20026
MASS SPECTROMETERS
design for analysis of fission product beams, 18: 20311
design of two-stage magnetic, 18: 20306
development of r-f, 18: 20618(R) (NP-13799)
performance for analysis of fission product beams, 18: 20312
use of time-of-flight, for retarding potential difference studies of appearance potentials, 18: 21703 (CONF-296-4)
MASS TRANSFER
mechanisms of gas-bubble, 18: 20189
MATERIALS TESTING
nondestructive methods of, 18: 21698(R) (ANL-6860)
radiographic and ultrasonic techniques for pressure vessels, 18: 20457(R) (SWRI-1228-19)
MATERIALS TESTING ACCELERATOR TARGETS
fabrication of bismuth, for polonium-208 production in Mark I, 18: 20486 (MTA-15)
MATERIALS TESTING REACTOR
design and operation of, manual for, 18: 21682 (IDO-16871-2)
MATHEMATICS
algebra of charged systems, 18: 20981
algorithm for matrix eigenvalue calculations, convergence of QR, 18: 21713 (NYO-10437)
analytic solution of the Percus-Yevick equation of statistical mechanics, 18: 21029
approximation method for diffraction problems, 18: 20657
intensive observables in quantum theory, 18: 21026
magnetogasdynamic constant Mach number duct equations, 18: 20839
model for predicting food crop contamination by fallout, 18: 19515 (NP-13796)
models for strontium metabolism in man, 18: 20235 (NP-13868)
probability in, informational model of, 18: 19512
singularities of solutions of nonlinear hyperbolic partial differential equations, 18: 20441
statistical mechanics of moderately dense fluids in, theory of irreversible, 18: 20633 (TID-20512)
theorem for stochastic methods, limiting, 18: 21734(T) (ORNL-tr-42)
use of Poisson collections in particle diffusion calculations, 18: 20442
weighting functions in weighted residual method, selection rule for, 18: 20440 (WAPD-T-1576(Rev.))
MATTER
electron range-energy relation in, semi-empirical, 18: 20929
MECHANICS
dynamics of nonlinear systems, frequency response characteristics in, 18: 21720 (SC-TM-264-63(15))
pair distribution function in statistical, Percus-Yevick equation for, 18: 21029
theory of momentum exchange in elastic scattering of neutral particles by crystals, 18: 21342
MEDICINE
problems in care of casualties from radiological warfare, 18: 19793
radiation in, code of practice for, 18: 20244
radiodiagnosis in dental, exposure from, 18: 20261
radioisotopes in, protective measures for using, 18: 20254
MELLITIC ACID
pyro- and tri-, analytical uses for gravimetric determination of hafnium and zirconium, 18: 19871
MELTING
electron-beam methods of, 18: 20491
MEMBRANES
preparation and properties of porous silver, for ultrafiltration, 18: 19934 (NP-13874)
radioinduced leukoplakia of oral, x, 18: 19624
MEMORY DEVICES
performance of ferrite-core, in spark chambers, 18: 20371
MERCHANT VESSELS
reactor for, design of Consolidated Nuclear Steam Generator II, 18: 21667 (BAW-1280)
MERCURY
analysis for mercury-197 and -203, calculation method for, 18: 20069
cavitation in flowing, void fraction measurements using gamma densitometer, 18: 20167 (NP-13812)
corrosive effects, 18: 21675 (NP-13795)
corrosive effects on Haynes 25 Alloy, tests of separator for products of, 18: 21677 (TID-20552)
corrosive effects on titanium, 18: 21698(R) (ANL-6860)
effects on thallium superconducting transition temperature, 18: 21113
electric discharge in, ionization phenomena in, 18: 21476
electron beam interactions in plasma of, cathode space charge in, 18: 21453
electron density distributions in plasma of, 18: 21465
ionization by electrons, cross sections for, 18: 20768
neutron scattering at 300 to 1500 kev, 18: 21698(R) (ANL-6860)
oscillations in plasma of, from electric current pulse, 18: 21461
performance as reactor coolant, evaluation of, 18: 20192
plasma of, charged-particle currents and temperatures in, 18: 21438
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
MERCURY ELECTRODES
development of dropping, 18: 19837(R) (MIT-905-1)
performance in perchlorate solutions, 18: 19837(R) (MIT-905-1)
MERCURY IONS
ionization of monovalent, by electrons, cross sections for, 18: 20768
recombination at electrodes, 18: 21712(R) (NYO-10065)
sputtering on metals at 10 to 2000 ev, energy spectra and yields from, 18: 20787
sputtering reactions on nickel, 18: 20666
MERCURY ISOTOPES Hg-195
nuclear magnetic moment and orientation of, 18: 21360
MERCURY ISOTOPES Hg-199
nuclear magnetic moment, 18: 21360
MERCURY ISOTOPES Hg-203
beta decay of, circular polarization in, 18: 21317
energy levels of, spin of ground-state, 18: 21317
MERCURY ISOTOPES Hg-204
production by monoisotopic photochemical process, estimated costs of, 18: 20429 (HW-71793)
MERCURY SYSTEMS
Ar–Hg, electric discharge in, resonance radiation from, 18: 21464
MERCURY URANATES
preparation and properties, 18: 20012
MESIC ATOMS
spectra of thallium μ-, effects of shell structure on, 18: 21331
MESON BEAMS
production and control, 18: 20703
separation of K and π, 18: 20680 (NIRL/R/49)
MESONS
interactions of pseudoscalar SU(3) octet, even-signature Regge poles in bootstrap dynamics of, 18: 21042
mass splittings of baryon-meson from symmetry-breaking tadpole diagrams, 18: 20941
mass vector for pseudoscalar octet in unitary symmetry, 18: 20939
production in proton-antiproton collisions, unitary symmetry model for, 18: 20953
Regge poles and resonances, 18: 20996
Regge poles in perturbation theory of, 18: 20997
resonances, spin-parity of, 18: 20998
symmetries of, R invariance in group, 18: 20995
MESONS (α)
properties of, π-π resonance, 18: 21001
MESONS (B)

model for, 18: 20958
parity and spin, 18: 20957
MESONS (β)
properties of, π-π resonance, 18: 21001
MESONS (η)
decay of, resonances in 3π, 18: 21021
interactions with hyperons (Σ), motion of poles in resonance, 18: 21016
properties of, π-π resonance, 18: 21001
MESONS (P)
decay of, parity and spin from $2\pi^0$, 18: 20960
production in meson (π^-)-proton interactions at 10 Bev/c, 18: 20960
MESONS (K)
decay of, resonances in 3-π, 18: 21021
interactions with protons at 2.00 Bev/c, elastic, 18: 20954
interactions with mesons (π), s- and p-wave resonances in, 18: 20977
interactions with hyperons (Ξ) and nucleons, motion of poles in resonance, 18: 21016
interactions with nucleons, S-wave, 18: 21020
resonance (K-π) in meson (π^-)-proton interactions, 726-Mev, 18: 20918 (UCRL-10797)
MESONS (K^-)
capture by nuclei, nuclear emulsion study of, 18: 20966
interactions in lithium-loaded nuclear emulsions at 1.5 Bev/c, hyperfragment production in, 18: 20938
interactions with protons at 1.80 and 1.95 Bev/c, hyperon (Ξ^-) production in, 18: 20959
interactions with protons, unitary symmetry model for, 18: 20962
interactions with deuterons and protons, Y_1^* resonance in, 18: 21020
interactions with protons, singularity in, 18: 20903 (JINR-E-1581)
interactions with deuterons at 100 to 150 Mev/c, effects of final-state interactions on cross sections for, 18: 20926
MESONS (K^0)
decay of, branching ratio for leptonic and nonleptonic, 18: 20973
lifetime and properties, 18: 20974
mass difference (K_1^0-K_2^0), theoretical calculation of, 18: 21007
spin-parity of resonance, Adair determination of, 18: 20998
MESONS (K^+)
decay of, analysis of 3-π, 18: 21018
decay of, branching ratio and meson (μ^-) energy spectra in, 18: 20961
MESONS ($K_{\mu 3}^+$)
decay of, branching ratio and meson (μ^-) energy spectra in, 18: 20961
MESONS ($K_{\pi 3}^+$)
decay of, $|\Delta T| = \frac{1}{2}$ rule in, 18: 21012
MESONS ($K_{\mu 3}^0$)
decay rate of, absolute, 18: 20956
MESONS ($K_{\pi 3}^+$)
decay, 18: 21018
MESONS (μ)
capture by helium-3, processes for, 18: 21326
capture by 2s-1d nuclei, Nilsson model calculations of rate of, 18: 21277
decay mediated by a vector boson, radiative corrections to, 18: 21010
decay of, strong interaction effects in Feinberg-Pais theory for, 18: 20950
field theory for, charge conservation in, 18: 21024
production of pure beams of, 18: 20703
properties of, CERN synchrotron research on weak and electromagnetic, 18: 20965
MESONS (μ^-)
capture by helium-3, rate of, 18: 21160 (CONF-231-5)
capture by nuclei, photon polarization in, 18: 21310
decay of, branching ratio for leptonic and nonleptonic, 18: 20973
MESONS (μ^+)
emission in meson ($K_{\mu 3}^+$) decay, energy spectra for, 18: 20961
MESONS (ω)
decay widths (three-π) of, R-conjugation invariance in strong-interaction, 18: 20949
effects on mass spectra of meson (π^-), proton interactions at 2.1 Bev/c, 18: 21017
properties of, nucleon coupling, 18: 21001
MESONS (ω^0)
spin-parity of, Dalitz determination of, 18: 20998
MESONS (ϕ)
decay widths (three-π) of, R-conjugation invariance in strong-interaction, 18: 20949
MESONS (π)
energy transfer in silicon at 0.5 to 1.5 Bev, 18: 20410
interaction resonance (π^+-π^-) in proton pair annihilation, 18: 20894 (BNL-7969)
interactions at high-energies, amplitudes in, 18: 20983
interactions of, mass distribution in resonance, 18: 20975
interactions with nucleons, detection of final state in, 18: 20401
interactions with nucleons, S-wave scattering lengths using N/D method for, 18: 20937
interactions with nucleons, nucleon Regge trajectories from, 18: 20940
interactions with nucleons, coupling constant on Regge trajectory for, 18: 20948
interactions with nucleons at 170 to 600 Mev, model for single meson (π) production in, 18: 20964
interactions with mesons (K), s- and p-wave resonances in, 18: 20977
interactions with nucleons, Regge poles in, 18: 20988
interactions with mesons (K), resonance, 18: 21003
interactions with nucleons, resonances in, 18: 21004
interactions with nucleons, resonances in, 18: 21005
interactions with hyperons, resonances in, 18: 21006
interactions with hyperons (Λ) at low energies, analysis of, 18: 21009
interactions with hyperons (Λ) and (Σ), motion of poles in resonance, 18: 21016
interactions with mesons (π), 2-π resonances in, 18: 21021
photoproduction on meson (π), integral equations for, 18: 20921
production in meson (π)-nucleon interactions at 170 to 600 Mev, model for single, 18: 20964
production in proton interactions, 18: 21213 (TID-20440)
properties of, CERN synchrotron research on weak and electromagnetic, 18: 20965
resonance (K-π) in meson (π^-)-proton interactions, 726-Mev, 18: 20918 (UCRL-10797)
resonances of 2 and 3, 18: 21001
resonances of, self-coupled fields for, 18: 21002
MESONS (π^-)
decay of, branching ratio for leptonic and nonleptonic, 18: 20973
interactions with protons at 1.4 to 3.0 Bev/c, tests of one-pion-exchange model for, 18: 20935
interactions with protons at 10 Bev/c, analyses of 4-prong, 18: 20951
interactions with protons at 10 Bev/c, meson (f^0) production in, 18: 20960
interactions with protons, unitary symmetry model for, 18: 20962
interactions with protons at 170 to 600 Mev, single meson (π) production in, 18: 20964
interactions with protons at 374, 417, and 454 Mev, neutron differential distributions in inelastic, 18: 21011
interactions with protons at 2.1 Bev/c, meson (ω) and (ρ) interference in, 18: 21017
interactions with nucleons at 17 Bev/c, 18: 20891 (AD-433625)
interactions with protons at 6.8 and 7.5 Bev/c, meson (π^0) production in, 18: 20902 (JINR-E-1557)
interactions with protons to 700 Mev, phenomenological analysis of, 18: 20915 (TID-20490)
interactions with protons, 726-Mev resonance (K-π) in, 18: 20918 (UCRL-10797)
production in electron-positron interactions, cross section for, 18: 20986
reactions (π^-,π^-n) with carbon-12 at 0.45 to 1.9 Bev, excitation function for, 18: 21293
MESONS (π^0)
existence of second, with rapid electron decay, 18: 20928
mass difference with mesons (π^+), theoretical calculation of, 18: 21007
production in meson (π^-)-proton interactions at 6.8 and 7.5 Bev/c, 18: 20902 (JINR-E-1557)
MESONS (π^+)
beta decay, 18: 20905 (JINR-P-1559)
decay into mesons (π^0), 18: 21306
interactions with protons to 700 Mev, phenomenological analysis of, 18: 20915 (TID-20490)
mass difference with mesons (π^0), theoretical calculation of,

18: 21007
production in electron-positron interactions, cross section for, 18: 20986
resonance (π^+p) at 1922 Mev, production in proton-proton peripheral collisions, 18: 20927
MESONS (ρ)
effects on mass spectra of meson (π^-)-proton interactions at 2.1 Bev/c, 18: 21017
production in meson (π)-nucleon interactions, 18: 20988
properties of, 2π resonance, 18: 21001
MESONS (X)
properties of, π-π resonance, 18: 21001
MESONS (ζ)
properties of, π-π resonances, 18: 21001
METABOLISM
dynamics of, in open biological systems, 18: 19537
effects on radioinduced dominant lethality in Drosophila oocytes, 18: 19622
kinetics of strontium, in man, 18: 20235 (NP-13868)
of aldosterone in man, 18: 19543
of dog body water, tracer study using deuterium, 18: 19530
radiation effects on lipid, in human bone marrow and leukocytes, 18: 19552(R) (NYO-2769-1)
radiation effects on *E. coli* DNA, x, 18: 19641
radiation effects on rabbit palmitic acid, x, 18: 19665
radiation effects on mouse and rat serum protein, x, 18: 19590
radiation effects on mouse blood cell and hematopoietic, x, 18: 19730
radiation effects on mouse carbohydrate, effects on phagocytosis in hematopoietic system, 18: 19734
radiation effects on bis(2-guanidoethyl) disulfide and 2-mercaptoethylguanidine, in mice, 18: 19772
use in studying, of digital printout system for whole-body scanners, 18: 20346
METALLIC FILMS
mechanical properties of thin, review, 18: 20515 (CONF-356-11)
METALLIC FOILS
pinch discharge on, plasma production in Z, 18: 21537
METALLURGY
book: *Solid State Diffusion in Metals and Alloys*, 18: 20536(T) (AEC-tr-6313)
METALS
analysis for oxygen, activation, 18: 19886
bibliography on liquid, 18: 20444 (AD-417111)
boiling and condensation of liquid, 18: 20174 (TID-7694(p.37-41))
book: *Effect of Radiation on Metals and Other High-Melting Materials*, 18: 20601
book: *Point Defects in Metals*, 18: 20568
corrosion by liquid metals, effects of polarization on, 18: 21698(R) (ANL-6860)
deposition by flame spraying, 18: 20134(R) (ORNL-TM-792)
determination of traces of, activation or isotope dilution, 18: 19852 (UJV-992/63)
diffusion in, book, 18: 20536(T) (AEC-tr-6313)
electronic properties of liquid, 18: 20628 (NP-13844)
electronic structure in nontransition, 18: 20548
heat transfer to liquid, in cross-flow through rod bundles, 18: 20185
heating loop for, emitter temperature distribution in electron, 18: 20183 (TID-18835)
hyperfine structure of, core-electron contribution to, 18: 20749
oxidation of, design of apparatus for measuring weight changes in, 18: 20480
physical properties of liquid, review, 18: 20516 (EUR-599.d)
purification by electron-beam melting, 18: 20491
shock-wave studies in, review of very high-pressure, 18: 20454 (LADC-5561)
sputtering by noble gas ions, 18: 20745
METEORITES
age determination from long-lived nuclides, 18: 20221
analysis for aluminum-26, beryllium-10, and chlorine-36, 18: 20221
analysis of, cosmic-ray variation determination by, 18: 20815 (BNL-7948)
cosmic-ray reactions with iron, magnesium, silicon, and sulfur in stony, production of helium-3 and neon-21 by, 18: 20204
diffusion of radiogenic and spallogenic rare gases from stony, 18: 20206
helium and neon contents and isotopic ratios in iron, 18: 20205
luminescence of stony, proton-excited, 18: 20072
rare gas isotopic content in, 18: 20726
METEOROIDS
effects on space vehicles, simulation of, 18: 20707
METEOROLOGY
stratospheric wind temperature and isobaric height conditions during IGY, 18: 20619 (TID-20511)
METEORS
conference on, 18: 20710 (AFCRL-62-497)
METHACRYLIC ACID, METHYL ESTER
radioinduced graft polymerization onto polystyrene, 18: 20096(R)
METHACRYLIC ACID, METHYL ESTER POLYMERS
neutron diffusion anisotropy in media with empty channels, thermal, 18: 21141
METHANE
diffusion coefficients in carbon tetrachloride, 18: 19963
electric discharge in, secondary ionization in, 18: 20137
electric discharge in, electron avalanches in, 18: 21490
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
thermal diffusion of carbon-13 in, 18: 21707(R) (MLM-1177)
thermal diffusion of carbon-13 in, 18: 21708(R) (MLM-1178)
thermal diffusion of carbon-13 in, 18: 21709(R) (MLM-1179)
methane–N, electron avalanche in discharges in, 18: 21491
METHANE, BROMO-
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, BROMOTRICHLORO-
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
METHANE, BROMOTRIFLUORO-
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, CHLORO-
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, CHLORODIFLUORO-
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
METHANE, CHLOROTRIFLUORO-
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
METHANE, DICHLORO-
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, DIFLUORO-
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, IODO-
effects on hydrogen yields in radiolysis of liquid hydrocarbons, 18: 20057
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANE, TRICHLOROFLUORO-
chlorine-37 neutron reactions in, chemically bound chlorine-38 from, 18: 20041 (MMPP-167-6)
flow of, heat transfer in two-phase, 18: 20171 (TID-7694(p.18-23))
METHANE, TRIFLUOROIODO-
reactions with recoil halogen atoms, 18: 20041 (MMPP-167-6)
METHANOL
nuclear magnetic resonance of sorbed, on thorium oxide, temperature dependence of, 18: 20632 (TID-18689)
spectra of uranium tetrachloride in, absorption, 18: 19935 (TID-18814)
METHYL SULFATES
t-butylmethylphenylsulfonium, preparation and nuclear properties, 18: 19837(R) (MIT-905-1)
METHYL SULFOXIDE
protective effects in Serratia against x radiation, 18: 19785
protective effects against radiation injuries in mice, effects of solvent on, 18: 19797
METHYLAMINE
separation from amines and amino acids by thin-layer chromatography,

ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
METROLOGY
prediction of subsequent measurements from partial information in quantum mechanics. 18: 21051
MICA
electron diffraction scattering by thin foils of, analyzing system for, 18: 20670
MICE
cell generative cycle in neoplastic mammary gland of, 18: 21701 (BNL-7925)
cerium-144 distribution after intravenous injection in, effects of sex on, 18: 19545
cerium-144, praseodymium-143, and yttrium-91 metabolism by, after inhalation as aerosol, 18: 19544
DNA synthesis inhibition by AET and cysteamine in, 18: 19524
effects of bacterial infection on skin homograft survival in, 18: 19511
effects of irradiation of graft site on transplanted unirradiated tumors in, x, 18: 19695
oxidation-reduction in tissues of, 18: 19680
ozone effects on x-irradiated erythrocytes in, 18: 19538
radiation chimeras in, effects of fetal thymus cell transplantation on, 18: 19766
radiation effects on zinc-65 metabolism by livers of, x, 18: 19531
radiation effects on lymphoid regeneration in, effects of thymus on x, 18: 19546
radiation effects on cell regeneration in, 18: 19553(R) (TID-20513)
radiation effects on parotitis virus reproduction in, x, 18: 19556(T) (JPRS-23956(p.9-17))
radiation effects on lymph node plasmacytic reaction in, x, 18: 19557(T) (JPRS-23956(p.18-26))
radiation effects on lethality in, fission neutron *vs.* gamma, 18: 19576
radiation effects on corneal and intestinal epithelium in, 18: 19689
radiation effects on sheep erythrocyte immunity in, continuous gamma, 18: 19623
radiation effects on deoxyribopolynucleotide content in hematopoietic and lymphatic tissues in, 18: 19630
radiation effects on stem cells in, effects of erythropoietin on, 18: 19635
radiation effects on bone marrow stem cell kinetics in fasted, 18: 19636
radiation effects on hind limb circulatory system, x, 18: 19640
radiation effects on transplantation antigens in, x, 18: 19589
radiation effects on blood serum metabolism in, x, 18: 19590
radiation effects on peritoneal cell transplants in, 18: 19591
radiation effects on bone marrow repopulation in, x, 18: 19592
radiation effects on splenic uptake of iron-59 by, x, 18: 19594
radiation effects on mitosis in, gamma, 18: 19609(T)
radiation effects on mitosis in, gamma, 18: 19610(T)
radiation effects on mitosis in malignant and nonmalignant epidermal hyperplasia in, 18: 19704
radiation effects on fertility of male, protection against, using serotonine, 18: 19711
radiation effects on mortality of, effects of age on spleen cell transfusions for, x, 18: 19727
radiation effects on blood cell and hematopoietic system metabolism in, x, 18: 19730
radiation effects on glycogen content of splenic leukocytes in, when used with antigens, x, 18: 19741
radiation effects on vitamin B_{12} content in kidneys and liver of, gamma and x, 18: 19743
radiation effects on splenic proteolysis in, x, 18: 19744
radiation effects on tissue cells of, wavelength-dependent, 18: 19757
radiation effects on hematopoietic cells of, repair of gamma, 18: 19761
radiation effects on bone marrow and spleen of, protective effects of homologous cells against, 18: 19767
radiation effects on, protective effects of bone marrow against, x, 18: 19770
radiation effects on bis(2-guanidoethyl) disulfide and 2-mercaptoethylguanidine distribution and metabolism in, x, 18: 19772
radiation effects on tumor-bearing, protective effects of chemicals against, 18: 19774
radiation effects on, protective effects of cysteamine against x, 18: 19775
radiation effects on, protective effects of fresh vs. stored bone marrow, 18: 19777
radiation effects on survival of, protective effects of cysteamine against, x, 18: 19788
radiation effects on, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and bone marrow against, 18: 19796
radiation effects on, protective effects of antioxidants against, 18: 19797
radiation effects on, protective effects of frozen and stored bone marrow against, x, 18: 19805
radiation effects on, protective effects of radiation-resistant whole bacterial cells against, 18: 19808
radiation effects of fractionated x-ray doses on embryonic development in, 18: 19719
radiation used with vaccination in, effects on lymph nodes and spleen, 18: 19740
radioinduced chromosomal aberrations in, method for radiation detection and dosimetry, 18: 19643
radioinduced chromosomal abnormalities in, x, 18: 19583
radioinduced leukemia in black, resistance to, 18: 19663
radioinduced myeloid leukemia in, physical factors affecting, gamma, fast neutron, x, 18: 19577
radioinduced myeloid leukemia in, virus effects on, x, 18: 19578
radioprotective effects of bone marrow and spleen preserved with PVP in, 18: 19778
radiosensitivity of, index for, 18: 19680
radiosensitivity of, effects of cystamine on, 18: 19800
tumor ultrastructure in, 18: 21732(T) (ANL-Trans-7)
MICROORGANISMS
radioinduced mutations in, ultraviolet, 18: 19650
MICROSCOPES
design of digitized, for analysis of particle tracks, 18: 20295
MICROWAVE EQUIPMENT
attenuation in spiral waveguides, 18: 20315
design and operation of 6-Bc series-tuned f-m discriminator for demodulation of fast-risetime telemetry, 18: 20285 (SCL-DR-64-13)
design for plasma diagnostics, 18: 21368 (AFCRL-63-161)
electromagnetic wave propagation in waveguides, analysis of, 18: 20623 (JINR-P-1565)
microwave propagation in plasma waveguide, 18: 21444
oscillations of open resonators and wave guides with plane mirrors, 18: 20313
oscillations of open resonators with cylindrical mirrors, 18: 20314
performance of 3-Gc circular guides, for charged-particle-beam separations, 18: 20925
MICROWAVE SPECTROSCOPY
methods of millimeter-wave molecular-beam, 18: 19990
MICROWAVES
emission by hydrogen plasma formed by electrodeless induction discharge, 18: 21394
plasma diagnostics using, 18: 21368 (AFCRL-63-161)
reactions with deuterium, electron ionization frequency for, 18: 21510
transmission by plasma cylinder, 18: 21372 (CLM-R-34)
MILITARY PERSONNEL
design of dual-use shelters for, 18: 20197 (NAVDOCKS-P-310)
MILK
fallout uptake by, in England, 18: 20208 (AERE-R-4415)
radioactivity of, German Federal Republic, Sept. 1961 to Sept. 1962, 18: 19809
MINERALS
analyses of, strontium contamination in, 18: 19888
analysis for cesium, lithium, and rubidium, spectroscopic, 18: 19853(T) (CEA-tr-R-1711)
MINING
cancer mortality attributable to uranium, 18: 20256
dust hazard prevention in nuclear materials, 18: 20270
radiological health and safety in, of nuclear materials, 18: 20267
radon and daughters in, measurement of, 18: 20268
ventilation in uranium, for radon and daughter control, 18: 20269
MITOCHONDRIA
radiation effects on L-cell, x, 18: 19783
MITOSIS
in bone marrow cells, 18: 19509
nucleoprotein turnover during, tracer study, 18: 19518 (BNL-7007)
photosynthetic activity during Euglena, 18: 21721 (TID-18753)

radiation effects on mouse, gamma, 18: 19609(T)
radiation effects on mouse, gamma, 18: 19610(T)
radiation effects on, in epidermal hyperplasia in mice, 18: 19704
radiation effects on frog, x, 18: 19781(T)
radiation effects on, in cornea and intestinal epithelia, 18: 19689

MIXER-SETTLERS
optimization of two-stage chemical, 18: 20156

MOAB DISTRICT (UTAH)
geology of mineralogical changes in uranium deposit sediments in, 18: 20228

MOLDS
radiation effects on mutation frequencies in Aspergillus, environmental modification of, uv, 18: 19724
radioinduced mutations in Neurospora, uv, 18: 19621

MOLECULAR BEAMS
scattering of, quantum-mechanical calculations of differential cross sections in small-angle, 18: 20736

MOLECULES
effects of heavy ions on, 18: 19571
electron impact excitation cross section for vibrational states of polyatomic, effects of vibrational mixing of first-order electronic wave function on, 18: 20760
hyperfine structure of, core-electron contribution to, 18: 20749
isotope effects on, calculation of initial and transitional state vibration frequencies for determination of, 18: 19951
reactions with atoms, vibrational energy transfer in, 18: 20776
reactions with ions, use of mass spectrometer in studies of, 18: 21703 (CONF-296-4)

MOLLUSKS
carbonate formation in shell of *Strombus gigas*, 18: 19520(R) (TID-20499)

MOLYBDATES
reactions with lanthanum, amperometric studies on, 18: 19901

MOLYBDENUM
analysis for copper, iron, nickel, titanium, and zirconium, classical methods for, 18: 19921
compatibility with thorium and uranium borides and carbides, 18: 20450(R) (BMI-1661(Del.))
compatibility with uranium nitride, 18: 20450(R) (BMI-1661(Del.))
corrosion by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
crystal dislocations in, internal friction from, 18: 20559
desorption of carbon monoxide and oxygen from, by electrons at 0 to 300 ev, 18: 20641
determination in nucleic acids, activation, 18: 19892
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
determination in uranium–molybdenum alloys, gravimetric, 18: 19846 (LA-3058)
determination using 1-mercaptopropionic and *p*-phenetidide-1-mercaptopropionic acids, photometric, 18: 19914
diffusion of boron and carbon in, conditions for, 18: 20540
electron emission by, in cesium atmosphere, 18: 21367(R) (AD-429133)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
performance compatibility with fission heat source in thermionic cells, 18: 20876
plastic deformation of single-crystal, mechanism of direct-shear, 18: 20563
radiation effects on mechanical properties of, review, 18: 20456 (ORNL-3593)
radiation effects on, stage III recovery from neutron, 18: 20596
radiation effects on thermal control coatings of, in nuclear spacecraft, 18: 20603
reactions with sodium sulfide to form molybdenum sulfide, 18: 20001
reactions with 1-mercaptopropionic acid derivatives, 18: 19914
xenon-131 ranges in, at 5 to 30 kev, 18: 20672

MOLYBDENUM ALLOYS
analysis for copper, iron, nickel, titanium, and zirconium, classical for, 18: 19921
corrosion by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
mechanical properties of, review, 18: 20456 (ORNL-3593)
Al–Mo, phase diagram, 18: 20549
Cr–Mo–Ni, corrosion of Incoloy and Timken 16-25-6, by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
Cr–Mo–Zr, corrosion by pressurized water and workability of, 18: 20461
Cr–Mo–Zr, heat treatment effects on mechanical properties and microstructure of, 18: 20461
Mo–Nb–V–Zr, fabrication of B-66, by extrusion and forging, 18: 20484(R) (AD-418992)
Mo–Nb–V–Zr, fabrication of B-66, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Mo–Nb–V–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated B-66, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Mo–Nb–W, fabrication of, effects on mechanical properties, 18: 20485 (ASD-TDR-62-670(Pt.II))
Mo–Ni–Zr, corrosion by pressurized water and workability of, 18: 20461
Mo–Ni–Zr, heat treatment effects on mechanical properties and microstructure of, 18: 20461
Mo–Rh–Ti, superconductivity, 18: 21112
Mo–Ti, emissivity measurements at 800 to 5000°K, 18: 20566
Mo–Ti, transformation characteristics during continuous cooling, 18: 20545
Mo–Ti–Zr, coating of TZM, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Mo–Ti–Zr, corrosion of platinum- and platinum–rhodium-clad TZM, by air at 2550°F, 18: 20445(R) (AD-434441)
Mo–U, analysis for molybdenum, gravimetric, 18: 19846 (LA-3058)
Mo–W, fabrication and properties of extruded and forged, 18: 20447(R) (ASD-TR-7-797(IX))
Mo–W, performance compatibility with thermionic cell fission heat source, 18: 20874

MOLYBDENUM CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974

MOLYBDENUM ELECTRODES
development for thermionic cells, 18: 20865
performance as thermionic emitter, 18: 20872
performance in neon glow discharge, effect of active gas additives on, 18: 21456

MOLYBDENUM ISOTOPES Mo-98
neutron reactions (n,γ) with, production of carrier-free technetium-99m by, 18: 20071

MOLYBDENUM SILICIDES
magnetic susceptibility, 18: 20541

MOLYBDENUM STEEL
corrosion by mercury, 18: 21675 (NP-13795)

MOLYBDENUM SULFIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
preparation from molybdenum and sodium sulfide, 18: 20001
properties for use as dry lubricant for bearings in dry helium atmosphere in reactors, 18: 21575

MOLYBDENUM SYSTEMS
C–Mo–Ti–Zr, dispersed phase studies in Mo-TZC, 18: 20512 (ASD-TDR-62-7(Pt.II))
Cr–Mo–Si, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)
Mo–Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)

MONAZITES
analysis for rare earths and thorium, 18: 19885

MONEL
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)

MONKEYS
radiation effects on responses of, x, 18: 19586

MONTE CARLO METHOD
use for determining error magnitudes for height and radius extrapolations for cylindrical reactor, 18: 21550 (EUR-1624.e)
use in calculation of electron-photon cascades, 18: 21322
use in polaron energy calculations, 18: 21737(T) (UCRL-Trans-1040(L))
use in reactor calculations, multigroup transport theory for, 18: 21601
use in solving gamma transport problems, 18: 20932

MOSQUITOES

radiosterilization of Anopheles, gamma, 18: 19654
MÖSSBAUER EFFECT
in dysprosium-161, effects of high pressures on, 18: 21214 (UCRL-10630(Rev.))
line broadening of Gaussian spectra from, 18: 21315
use in chemistry and solid-state physics, 18: 19998
MOUTH
radiation effects on oral membranes of human, x, 18: 19624
MULTIPLICATION FACTOR
reactivity of subcritical assemblies, 18: 21607
MUSCLES
radiation effects on regeneration of mouse, after trauma, 18: 19553(R) (TID-20513)
radiation effects on extracellular space in, 18: 19718
radiation effects on proteolysis in rat skeletal, gamma, 18: 19745
radiotoxins released by, 18: 19653
MUTATIONS
radioinduced in Aspergillus, environmental modification of frequencies of, 18: 19724
radioinduced in *Bacillus subtilis*, ultraviolet, 18: 19753
radioinduced in Drosophila, dose-rate effects on, 18: 19646
radioinduced in microorganisms, ultraviolet, 18: 19650
radioinduced in Neurospora, uv, 18: 19621
role of, in carcinogenesis, 18: 19505 (BNL-7912)
use of A-B translocations in studies of, in maize, 18: 19513

N

NAGASAKI
carcinogenesis and leukemia in, 18: 19581
radioinduced carcinogenesis in, from atomic bomb explosion, 18: 19580
tumor incidence in populations of, 18: 19596
NAPHTHALENE
alpha and electron excitation of, pulse-height ratios for, 18: 20408
electric potentials, 18: 19837(R) (MIT-905-1)
radiolysis of, yield of free radicals of, 18: 20042 (USNRDL-TR-718)
use in tritium detector, 18: 19887
NAPHTHALENE, DECAHYDRO-
9-chloro-, reduction with tributyltin hydride, 18: 19837(R) (MIT-905-1)
2-NAPHTHOL, 1-(2-PYRIDYLAZO)-
analytical uses for spectrophotometric determination of uranium, 18: 19900
NECK
radiation effects on growing larynx in rabbit, 18: 19700
NEODYMIUM
content and relative abundances in terrestrial materials, 18: 20202
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from americium and samarium by ion exchange, 18: 21707(R) (MLM-1177)
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from samarium, 18: 21708(R) (MLM-1178)
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
NEODYMIUM ALLOYS
Mg–Nd, corrosion of, effects of cobalt and gallium on, 18: 20482
Nd–Sc, phase diagram, 18: 20520 (IS-841)
Nd–Tm, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
Nd–Y, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
Nd–Y, phase diagram, 18: 20520 (IS-841)
NEODYMIUM BORIDES
thermodynamic properties of hexavalent, 18: 19928 (CONF-405-6)
NEODYMIUM ETHYL SULFATES
cerium-139 and -141 gamma spectra in, plane polarization of, 18: 21274
NEODYMIUM ISOTOPES Nd-146
neutron reactions (n,γ) with, production of carrier-free promethium-147 by, 18: 20071
NEODYMIUM ISOTOPES Nd-147
energy levels of, spins and parities of, 18: 21208 (NP-13841)
NEODYMIUM ISOTOPES Nd-150
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
NEODYMIUM NITRATES
effects on blood coagulation, 18: 19535
separation by solvent extraction using TBP, calculation of cascade stagewise conditions for, 18: 20098 (IS-780)
solubility polytherms of systems with other ceric earths, 18: 20108
NEODYMIUM OXIDES
analysis for oxygen, 18: 19907
NEON
content in iron meteorites, 18: 20205
electric discharge in, moving striations in, 18: 21451
electric discharge in, cathode performance in, 18: 21456
electric discharge in, ionization coefficients for, 18: 21477
electric discharge propagation in rarefied, 18: 21511
electron multiple scattering at 40 to 130 kev, linear displacement distributions in, 18: 21316
electron scattering at 25 kev, cross sections for and optical transitions in, 18: 20764
electron vacancies in, readjustment to inner, 18: 20729 (CONF-481-6)
ionization by electrons, cross sections for, 18: 20768
lithium-7 scattering at 7 to 60 kev, angular distributions from, 18: 21318
photoionization cross sections for 80 to 600 Å, 18: 20728 (AD-412421)
plasma of, stability of a-c positive column of, 18: 21412
radioinduced ionization in thermionic cells, fission-fragment, 18: 20860
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
NEON IONS
reactions with argon and nitrogen, method for studying interchanges in, 18: 20021
reactions with crystal surfaces at 4 to 100 ev, Auger electron yield in, 18: 20780
sputtering on copper at 10 to 40 kev, temperature dependence of, 18: 20784
sputtering on metals at 20 to 1000 ev, mass dependence of, 18: 20786
wave functions for $1s^22s2p^6$ configuration of, self-consistent, 18: 20759
NEON ISOTOPES
separation by thermal diffusion, 18: 21708(R) (MLM-1178)
separation by thermal diffusion, 18: 21709(R) (MLM-1179)
NEON ISOTOPES Ne-19
energy levels, 18: 21352
NEON ISOTOPES Ne-20
content in meteorites, 18: 20726
energy levels at ground to 6.75 Mev, production and properties of, 18: 21241
NEON ISOTOPES Ne-21
content in iron meteorites, 18: 20205
content in meteorites, 18: 20726
production by cosmic-ray reactions with iron, magnesium, silicon, and sulfur in stony meteorites, 18: 20204
NEON ISOTOPES Ne-22
content in meteorites, 18: 20726
energy levels at 1.28, 3.35, and 4.47 Mev, branching ratios, multipole mixing ratios, and spins of, 18: 21246
reactions with uranium-238, production of nobelium-256 in, 18: 21183 (JINR-P-1580)
NEON SYSTEMS
Ar–Ne, radioinduced ionization in thermionic cells, fission-fragment, 18: 20860
Ne–O, electric discharge in, cathode performance in, 18: 21456
Ne–O, radiolysis of, ozone formation in, 18: 20095
NEPTUNIUM
oxidation state in aqueous media, determination of, 18: 19896
separation from aqueous media by solvent extraction using lanthanum fluoride and TTA, 18: 19896
NERVOUS SYSTEM
effects of melanins on, in mammals, 18: 21700 (BNL-7855)
radiation effects on monkey and rat, x, 18: 19586

radiation effects on, in antenatally irradiated dogs, 18: 19608(T)
radiation effects on rat, x, 18: 19729
radiodiagnosis of spinal cord resulting in injuries of, Thorotrast, 18: 19659
NEUTRINOS
experiments on, 18: 20900 (CERN-64-6(p.99-123))
properties of, research at CERN on, 18: 20967
properties of, review of, 18: 20919
solar flux and elastic scattering, limits on, 18: 20713
NEUTRON-ABSORPTION ANALYSIS
use for determination of moisture in soil and building materials, 18: 19905
use in determination of carbon-hydrogen ratio of hydrocarbons, 18: 19904
NEUTRON BEAMS
extraction from reactors, systems for, 18: 21566 (KR-64(Sect.XXIX))
filtering and shielding techniques for, 18: 21130 (KR-64(Sect.XXX))
production of polarized, 18: 20368
production of subthermal, by total internal reflection, 18: 21120 (AMRA-TR-63-25)
reflection of thermal, from collimator walls, 18: 21126 (KR-64(Sect.XXIV))
transport of polarized thermal, 18: 21125 (KR-64(Sect.XXIII))
NEUTRON CROSS SECTIONS
library of, Winfrith, 18: 21156 (AEEW-R-351)
tables of nine- and sixteen-group, for tungsten, 18: 21168 (GEMP-223)
tables of nine-group, 18: 21170 (GEMP-279)
NEUTRON PHOTOGRAPHY
use in irradiated fuel radiography, 18: 20591
NEUTRON RESONANCE CROSS SECTIONS
determination, 18: 21164 (CONF-481-36)
NEUTRON SCATTERING CROSS SECTIONS
theory of, using irreversible statistical mechanics of moderately dense fluids, 18: 20633 (TID-20512)
NEUTRON SHIELDING
design for use with beams, 18: 21130 (KR-64(Sect.XXX))
dosimetry in ducts in, 18: 21546 (NP-13805)
testing facility for, 18: 21546 (NP-13805)
NEUTRON SOURCES
calibration of, by manganese sulfate bath method, 18: 21124 (IA-800)
collimator for 14-Mev, development of steel, 18: 19821
counting rates for, effects of temperature on measured, 18: 21709(R) (MLM-1179)
description of pulsed, for in-pile uses, 18: 21605
design for simulating thermonuclear explosions, 18: 21546 (NP-13805)
evaluation of, for small laboratories, 18: 21139
neutron growth rate of plutonium-beryllium, 18: 21707(R) (MLM-1177)
use for reactivity measurements on subcritical assemblies, pulsed, 18: 21607
NEUTRON SPECTRA
calculation of thermal, in homogeneous media, comparison of codes for, 18: 21122 (EUR-1605.e)
in graphite, 18: 21146
in moderator with temperature discontinuity, 18: 21145
measurement for polonium-beryllium source after passage through water shield, 18: 21136
NEUTRON SPECTROMETERS
burst shape measurement and prediction for multi-rotor choppers, 18: 20339 (TID-20504)
characteristics of r-f polarized, 18: 20368
chopper calculations for divergent beam geometries in, 18: 20385
choppers for, design of three-rotor, 18: 20388
circuit for improving resolution in time-of-flight many-layer, 18: 20338 (PAN-469/I)
design, 18: 21708(R) (MLM-1178)
design of recoil, for fast neutrons, 18: 20365
design of time-of-flight, with variable-bandwidth encoder, 18: 20363
design of time-of-flight, for fission neutrons, 18: 20384
properties of semiconductor, 18: 20334 (KR-64(Sect.XXXI))
spectral range of helium-3, extension of, 18: 20359
NEUTRONS
absorption by materials, DIRAC optical distribution function for, 18: 21151
age in Dowtherm-A, 18: 21138
albedo on slabs, transport solution for, 18: 21134 (TID-20540)
attenuation in thermal shielding for power reactors, calculation of, 18: 21636 (HW-72844)
beta decay of, half life for, 18: 21129 (KR-64(Sect.XXVII))
beta decay of, parameters for, 18: 21128 (KR-64(Sect.XXVI))
capture by nuclei, electron distributions from, 18: 20332 (KR-64 (Sect.XII))
capture of polarized, beta decay of polarized nuclei from, 18: 21201 (KR-64(Sect.XXVIII))
chemical effects on carbon tetrachloride–white phosphorus reactions, 18: 20091
chemical effects on amides and amidines, 18: 20092
chemical effects on aromatic petroleum fractions, 18: 19836 (EUR-496.f)
cytological effects in human marrow, 18: 19602
detection and measurement of, semiconductor counters for, 18: 20334 (KR-64(Sect.XXXI))
detection and measurement using organic scintillators, gamma-neutron discrimination in, 18: 20350
detection and measurement of, helium-filled scintillation detector for, 18: 20398
detection and measurement in reactor, feasibility of in-core ion chambers for, 18: 21563(R) (GEAP-4483)
diffusion in polyethylene, extrapolation lengths at different energies for, 18: 21132 (RPI-328-4)
diffusion of, multigroup equations for, 18: 21155
diffusion theory of, comparison with energy-dependent transport theory solutions, 18: 21153
distributions in light-water-moderated reactors, effects of energy on, 18: 21608
distributions in multiplying media, theory of prompt-decay constants and spectra for, 18: 21149
distributions in multiplying media, prompt-decaying eigenstates for thermal and slowing-down range in, 18: 21150
effects on beryllium oxide at 900°C, 18: 20605
effects on copper, relation between prismatic dislocations and change in volume during annealing, 18: 20599
effects on dimensional stability of steel, 18: 20584 (SC-R-64-120)
effects on engineering materials in vacuum and/or at cryotemperatures, 18: 20581(R) (FZK-172)
effects on genetic response of Drosophila spermatozoa, 18: 19647
effects on human chromosomes, 18: 19582
effects on macroscopic growth of magnesium oxide crystals, 18: 20597
effects on molybdenum and niobium, annealing of, 18: 20596
effects on nuclear thermionic cells, 18: 20882
effects on oxidation of graphite at 350 to 500°C, 18: 20580 (BNL-7964)
effects on rocket reactor thermal control materials, 18: 20603
effects on thermal conductivity of pyrolytic carbon and graphite, 18: 20450(R) (BMI-1661(Del.))
effects on thermionic cell performance, 18: 20881
effects on urinary excretion of amino acids, 18: 19638
effects on work hardening of copper, 18: 20600
effects on x-ray line broadening of beryllium oxide, 18: 20608
effects on x-ray scattering by beryllium oxide, 18: 20607
flux fine structure in uranium dioxide clusters, 18: 21612 (CEA-2387)
interactions of, mass distribution in resonance, 18: 20975
interactions with protons at 128 Mev, triple-scattering parameter for, 18: 20933
interactions with protons at 126 Mev, polarization in, 18: 20934
interactions with protons, Regge trajectories for, 18: 20936
interactions with protons at 23.1 Mev, phase shift analysis of, 18: 20904 (JINR-P-1553)
photoproduction on thick targets, measurement of, 18: 21308
production by proton reactions with nuclei at 6 Bev, 18: 21698(R) (ANL-6860)
production in proton-antiproton collisions, unitary symmetry model for, 18: 20953
reactions (n,α) with uranium-238, instrument for detection of alpha particles from, 18: 20403
reactions (n,α) with boron-10 gases, pressure wave generation in, 18: 21268
reactions (n,γ) with nuclei, gamma spectra from, 18: 20333 (KR-64 (Sect.XX))

reactions (n,γ) with samarium at 10 to 20 ev, spectra from, 18: 20388
reactions (n,γ) with neodymium-146, production of carrier-free praseodymium-147 by, 18: 20071
reactions (n,γ) with cerium-142, production of carrier-free praseodymium-143 by, 18: 20071
reactions (n,γ) with molybdenum-98, production of carrier-free technetium-99m by, 18: 20071
reactions (n,γ) of polarized, polarization of photons from, 18: 21200 (KR-64(Sect.XXII))
reactions (n,γ) with rhenium, gamma spectra from, 18: 21205 (NP-13807)
reactions (n,γ) with nickel-60, angular correlation of 7.54–0.284 Mev cascade in, 18: 21240
reactions (n,γ) with nuclei, analysis of gamma spectra from, 18: 21202 (KR-64(Sect.XXXII))
reactions (n,f) with plutonium-239, plutonium-241, uranium-233, and uranium-235, resonance integrals for, 18: 21166 (CRRP-1183)
reactions (n,f) with uranium-235 and uranium-238 at 2.5 and 14 Mev, probability of ternary, 18: 21219
reactions (n,f) with uranium-235, beta decay and delayed gammas following, 18: 21297
reactions (n,p) with nuclei, optical model analysis of, 18: 21165 (CONF-490-1)
reactions in inert gas-filled thermionic diodes, space-charge neutralization in, 18: 20861
reactions with aluminum, carbon, fluorine, and hydrogen at 2.77 Mev, total cross sections for, 18: 21159 (CEA-2399)
reactions with nitrogen-14 in atmosphere, 18: 20817
reactions with nuclei, gamma production cross sections for, 18: 21169 (GEMP-278)
reactions with nuclei, neutron distributions from [illegible], 18: 21197 (KR-64(Sect.XVIII))
reactions with polarized nuclei, resonance effects in, 18: 21127 (KR-64(Sect.XXV))
reactions with reactor matrices composed of coaxial cylindrical regions, calculation of fast fission effect for, 18: 21609
scattering by bismuth, tantalum, thorium, and uranium at 15.2 Mev, angular distributions in elastic, 18: 21340
scattering by gold, mercury, and thallium at 300 to 1500 kev, 18: 21698(R) (ANL-6860)
scattering by lithium-6 and -7 at 14 Mev, angular and energy distributions from, 18: 21263
scattering by nuclei at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
scattering in fast reactors, matrices for inelastic, 18: 21598 (IA-899)
slowing down theory for, anisotropic scattering in, 18: 21135 (UCRL-7006-T)
streaming in concrete ducts, dose measurements for, 18: 21546 (NP-13805)
thermalization of, transient phenomena in theory of, 18: 21142
thermalization of, transient phenomena in theory of, 18: 21143
transport equations for, computer program for, 18: 21123 (GA-4972)
transport equations for adjacent half spaces, solution of one-speed, 18: 21133 (TID-20503)
transport in adjacent half-spaces, Case's method in one-speed, 18: 21140
transport theory of, solutions to the source-free energy-dependent Boltzmann equation for, 18: 21153
transport theory of, abstract approach to unique solution of, 18: 21154
tumor-therapy model, 18: 19816
x-ray emission by stars of, surface, 18: 20711

NEUTRONS, COLD

scattering by beryllium oxide crystals, 18: 20574
scattering of, review of inelastic, 18: 21121 (BNL-7958)

NEUTRONS, DELAYED

distributions of, from fission fragments, 18: 21196 (KR-64(Sect.XVII))
production of, contribution of bromine and iodine isotopes to, 18: 21221

NEUTRONS, FAST

age-diffusion equation for, 18: 21603
biological effects on life span and morphology of peripheral blood in white rats, 18: 19677
detection and measurement using semiconductor detectors, 18: 20413
distributions in cube-shaped room with source in center, 18: 21137
dose rate behind shielding plugs in Battelle shielding facility, 18: 21543 (BMI-1384)
effects on beryllium at 450 to 650°C, 18: 20579 (AAEC/E-115)
effects on beryllium oxide at 75 and 500 to 700°C, 18: 20610
effects on cherry graft development, 18: 19691
effects on copper, thermal activation of slip in, 18: 20594
effects on density, lattice parameters, and size of beryllium oxide crystals at 75 to 100°C, annealing effects on, 18: 20609
effects on green and yellow excited absorption spectra of cuprous oxides, 18: 20077
effects on low-temperature dielectric relaxation in fused silica, 18: 20616
effects on silicon surface-barrier detectors, 18: 20357
effects on solid lubricant materials, 18: 20585 (WANL-TNR-109)
effects on strength of magnesium oxide crystals, 18: 20595
effects on tensile properties of type 347 stainless steel pressure tube, effects of annealing on, 18: 20450(R) (BMI-1661(Del.))
effects on thermal conductivity of beryllium oxide at 2 to 300°K, 18: 20611
leukemogenic effects in mice, physical factors affecting, 18: 19577
reactions (n,f) with plutonium-239, thorium-232, uranium-233, uranium-235, and uranium-238, delayed gammas from, 18: 21296
slowing-down time in water to cadmium edge, 18: 21148
spectra of, recoil spectrometers for analyzing, 18: 20365

NEUTRONS, FISSION

detection and measurement of, spectrometer for, 18: 20384
effects on mouse lethality compared with gamma rays, 18: 19576

NEUTRONS, PROMPT

distributions from neutron-induced and spontaneous fission, 18: 21197 (KR-64(Sect.XVIII))
emission by fission fragments, 18: 19837(R) (MIT-905-1)
production in uranium-235 fission, distributions of, 18: 21198 (KR-64(Sect.XIX))

NEUTRONS, RESONANCE

capture by gadolinium, 18: 21164 (CONF-481-36)
distributions in cube-shaped room with source in center, 18: 21137
scattering by aluminum and sodium, 18: 21698(R) (ANL-6860)

NEUTRONS, THERMAL

capture by nuclei, gamma spectra from, 18: 21193 (KR-64(Sect.XIV))
detection and measurement using conversion electrons from cadmium and gadolinium, 18: 21564(R) (GEMP-81)
detection using coaxial-symmetrical flow spark counter, 18: 20348
diffusion in plexiglas system with empty channels, 18: 21141
diffusion in reactor moderators, effects of empty channels on, 18: 21602
distributions in cube-shaped room with source in center, 18: 21137
dose rate behind shielding plugs in Battelle shielding facility, 18: 21543 (BMI-1384)
effects on green and yellow excited absorption spectra of cuprous oxides, 18: 20077
flux behavior in exponential and pulsed experiments, Boltzmann transient, 18: 21142
flux behavior in exponential and pulsed experiments, Boltzmann transient, 18: 21143
flux perturbations of, effects of flux anisotropy on, 18: 21152
reactions (n,γ) with nuclei, gamma-gamma correlations from, 18: 21199 (KR-64(Sect.XXI))
reactions (n,γ) with chlorine-35, angular distributions of electron-positron pairs from, 18: 21236
reactions (n,γ) with selenium-77, sum-coincidence studies of gamma cascades from, 18: 21329
reactions (n,f) with uranium-235, prompt neutron distributions from, 18: 21198 (KR-64(Sect.XIX))
reactions (n,f) with uranium-235, mass distribution for binary and ternary, 18: 21280
reactions with cadmium-108, activation cross sections for, 18: 21220
reactions with nuclei, charge and mass distributions from fission, 18: 21195 (KR-64(Sect.XVI))
reactions with uranium-235, mass distributions from fission, 18: 20358
reflection from collimator walls, multiple, 18: 21126 (KR-64(Sect.XXIV))
scattering by nonabsorbing media, effects of chemical binding on Milne-problem extrapolation distance in, 18: 21147
scattering by pyrrhotite crystal, magnetic inelastic, 18: 21131

(PAN-279)
scattering by semi-infinite nonabsorbing gas, energy-dependent Milne problem for, 18: 21144
spectra in graphite systems, 18: 21146
spectra in homogeneous media, calculation of, 18: 21122 (EUR-1605.e)
spectra in moderator with temperature discontinuity, 18: 21145
transport of polarized beams of, 18: 21125 (KR-64(Sect.XXIII))
use in nuclear physics, advanced course on, 18: 21185 (KR-64)
utilization factors for, in lattice cells, 18: 21597 (EUR-1606.e)

NEW ENGLAND REGION
radioinduced leukemia in, background, 18: 20214

NEW ZEALAND
fallout monitoring, 1963, 18: 20234(R) (NP-13859)

NICKEL
analysis for oxygen, activation, 18: 19886
corrosion by cesium at 750°C, 18: 20873
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)
deposition on aluminum-clad fuel elements by chemical method, 18: 20453 (HW-72415)
determination in molybdenum, tungsten, and their alloys, classical methods for, 18: 19921
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
helium-3 elastic scattering at 20 Mdv, differential cross sections for, 18: 21359
ion reactions at 4 to 100 ev, Auger electron yield in, 18: 20780
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
sputtering by krypton and mercury at 10 to 2000 ev, energy spectra and yields from, 18: 20787
sputtering by mercury ions, 18: 20666
sputtering by rare gas ions at 20 to 1000 ev, mass dependence of, 18: 20786
stacking-fault energy, 18: 20550
xenon-131 ranges in, at 5 to 30 kev, 18: 20672

NICKEL ALLOYS
Al–Cr–Ni–Ti, corrosion of Inconel 702 by superheated steam, 18: 21668(R) (GEMP-274)
Al–Ni–Nb, oxidation rate of Ni_2Al_3Nb, 18: 20478
Cr–Mo–Ni, corrosion of Incoloy and Timken 16-25-6, by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
Cr–Ni, creep properties, 18: 21668(R) (GEMP-274)
Cr–Ni, oxidation by air and steam, 18: 21668(R) (GEMP-274)
Fe–Ni, corrosion by cesium at 750°C, 18: 20873
Mo–Ni–Zr, corrosion by pressurized water and workability of, 18: 20461
Mo–Ni–Zr, heat treatment effects on mechanical properties and workability of, 18: 20461
Ni–Pd, corrosion by cesium at 750°C, 18: 20873
Ni–Rh–Ti, superconductivity, 18: 21112

NEPTUNATES
preparation attempts by pyrolysis of neptunyl nitrate and metal nitrate mixtures, 18: 20012

NICKEL COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946

NICKEL ELECTRODES
electric breakdown and electron emission in vacuum, mechanisms of, 18: 20139
performance in neon glow discharge, effect of active gas additives on, 18: 21456

NICKEL ISOTOPES Ni-56
energy levels and mass of, determination of, 18: 21357

NICKEL ISOTOPES Ni-57
energy levels from (p,d) reactions, spins of, 18: 21299

NICKEL ISOTOPES Ni-58
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
alpha reactions (α,αn), (α,α2n), (α,αp), and (α,αpn) at 46 to 68 Mev, recoil ranges of product ions from, 18: 21294
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
helium-3 reactions (He^3,d) with, 18: 21204 (LADC-6302)
neutron reactions (n,p) with, optical model analysis of, 18: 21165 (CONF-490-1)
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
proton inelastic scattering at 10.3 Mev, 18: 21252
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
proton reactions (p,d) at 28 Mev, angular dependence on final state spin in, 18: 21299

NICKEL ISOTOPES Ni-59
energy levels from (p,d) reactions, spins of, 18: 21299

NICKEL ISOTOPES Ni-60
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering by, 18: 21161 (CONF-417-26)
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron reactions (d,t) at 14.7 Mev, spin dependence of angular distributions from, 18: 21301
neutron reactions (n,γ) with, angular correlation of 7.54–0.284 Mev cascade in, 18: 21240
neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
proton reactions (p,d) at 28 Mev, angular dependence on final state spin in, 18: 21299

NICKEL ISOTOPES Ni-61
energy level at 284 kev, spin of, 18: 21240
energy levels from (p,d) reactions, spins of, 18: 21299

NICKEL ISOTOPES Ni-62
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
helium-3 reactions (He^3,d) with, distorted-wave analysis of, 18: 21204 (LADC-6302)
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
proton reactions (p,d) at 28 Mev, angular dependence on final state spin in, 18: 21299

NICKEL ISOTOPES Ni-64
alpha elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292
deuteron reactions (d,t) at 14.7 Mev, spin dependence of angular distributions from, 18: 21301
proton elastic scattering at 7 to 12 Mev, angular distributions from, 18: 21292

NICKEL OXALATES
radiation effects on thermal decomposition of, 18: 20061

NICKEL OXIDES
performance of cesium-coated, as collector for thermionic cells, 18: 20870

NICKEL SYSTEMS
B–Cr–Ni, corrosion by cesium at 750°C, 18: 20873
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
Mo–Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)

NICOTINE

radiation effects on content in nicotiana plants, 18: 19690

NIOBIUM

analysis for oxygen, comparison of activation and vacuum fusion methods, 18: 19922
compatibility with thorium and uranium borides and carbides, 18: 20450(R) (BMI-1661(Del.))
deformation of flash- and vacuum-annealed, mechanisms of, 18: 20543
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
determination using diazo and monoazo compounds, photometric, 18: 19913
diffusion in vanadium, concentration gradients of, 18: 20512 (ASD-TDR-62-7(Pt.II))
diffusion of boron and carbon in, conditions for, 18: 20540
preparation of, by reduction of niobium pentachloride using hydrogen, 18: 20009
radiation effects on mechanical properties of, review, 18: 20456 (ORNL-3593)
radiation effects on, stage III recovery from neutron, 18: 20596
reactions with diazo and monoazo compounds, color, 18: 19913
sorptive properties and work function of, 18: 20564
spalling of aluminum coatings on, at high temperatures, 18: 20474 (TID-12794)
superconducting critical fields of films of, 18: 21114

NIOBIUM ALLOYS

bibliography on corrosion-resistant, 18: 20475 (VDDIT-87)
mechanical properties of, review, 18: 20456 (ORNL-3593)
properties for use as jacket material for fast reactor fuels, 18: 21698(R) (ANL-6860)
Al–Nb, spalling at high temperatures, 18: 20474 (TID-12794)
Al–Ni–Nb, oxidation rate of $Ni_2Al–Ni_2Nb$, 18: 20478
Mo–Nb–V–Zr, fabrication of B-66, by extrusion and forging, 18: 20484(R) (AD-418992)
Mo–Nb–V–Zr, fabrication of B-66, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Mo–Nb–V–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated B-66, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Mo–Nb–W, fabrication of, effects on mechanical properties, 18: 20485 (ASD-TDR-62-670(Pt.II))
Nb–Rh–Ti, superconductivity, 18: 21112
Nb–Ru, thermodynamic properties, paramagnetic susceptibility, and superconducting transition temperature, 18: 20557
Nb–Sn, superconductivity of, effects of substitution of other elements for part of tin on, 18: 21110
Nb–Ta, spectrographic analysis for hafnium, thorium, titanium, and zirconium simultaneously, 18: 19912
Nb–Ta–W–Zr, coating of FS-85, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, corrosion of platinum- and platinum–rhodium-clad FS-85, by air at 2200 and 2550°F, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, fabrication of FS-85, by forging, 18: 20484(R) (AD-418992)
Nb–Ti, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Nb–Ti, transformation characteristics during continuous cooling, 18: 20545
Nb–V, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Nb–W, fabrication of, effects on mechanical properties, 18: 20485 (ASD-TDR-62-670(Pt.II))
Nb–W–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated D-43, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Nb–Zr, emissivity measurements at 800 to 5000°K, 18: 20566
Nb–Zr, fabrication effects on superconducting current capacities of, 18: 21098

NIOBIUM BORIDES

emissivity measurements to 3000°K, equipment for, 18: 20567

NIOBIUM CARBIDES

emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
free energy of formation at 1180 to 1370°K, 18: 19970
Co–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Co–NbC–TaC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–NbC–TaC–TiC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Mo–Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)

NIOBIUM CHLORIDES

reduction to niobium by hydrogen, 18: 20009

NIOBIUM ISOTOPES Nb-93

neutron scattering at 1 to 4 Mev, cross sections for energy level excitation in, 18: 21217

NIOBIUM ISOTOPES Nb-95

beta decay of, circular polarization of gamma radiation following, 18: 21309
body burden in Alaska, 18: 20231 (HW-SA-3048)
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)

NIOBIUM OXIDES

crystal structure of $Nb_2O_5 \cdot 3WO_3$, 18: 19941
free energy of formation at 1050 to 1200°K, 18: 19973
$As_2O_5–Nb_2O_5$, crystal structure of tetragonal phases in, 18: 19942
$GeO_2–Nb_2O_5$, crystal structure of tetragonal phases in, 18: 19942
$Nb_2O_5–P_2O_5$, crystal structure of tetragonal phases in, 18: 19942
$Nb_2O_5–V_2O_5$, crystal structure of tetragonal phases in, 18: 19942

NIOBIUM SILICIDES

magnetic susceptibility, 18: 20541

NITRATES

content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)
formation in radiolysis of glycine-quartz solutions, 18: 20045

NITRIC ACID

effects on stress corrosion cracking of 18-8 stainless steel in dilute chloride solutions, 18: 20471 (CONF-492-2)
separation from aqueous solutions by solvent extraction using long-chain amines, 18: 20107
$HNO_3–TBP–H_2O$, calculation of cascade stagewise conditions for rare earth separation, 18: 20098 (IS-780)
kerosene–HNO_3–TBP, degradation and cleanup, 18: 20100 (ORNL-3524)

NITRITE IONS

density in lower ionosphere, 18: 21075

NITRITES

content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)

NITROGEN

compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
density in lower ionosphere, 18: 21075
determination in lubricants, computer routine for activation, 18: 19918
diagnostics of plasma of, by optical spectra analysis, 18: 21497
diffusion coefficients in carbon tetrachloride, 18: 19963
effects in potassium-sodium reactor coolant, 18: 21661
effects on genetic response of Drosophila spermatozoa to x radiation, 18: 19647
electric breakdown in plane-point and plane-wire gaps, 18: 20148
electric discharge in, triggering mechanism for undervolted, 18: 20149
electric discharge in, theory of self-quenching, 18: 21475
electric discharge in, electron avalanches in, 18: 21490
electric discharge in, electron avalanches in, 18: 21491
electric discharge in, formative time lags in, 18: 21493
electric discharge in, vortex stabilization of, 18: 21495
electric discharge in crossed fields, rotational properties of, 18: 21501
electric discharge in, ohmic heating in transient, 18: 21522
electric discharge in, photon absorption in, 18: 21474
irradiated gas effects on Azotobacter nitrogen fixation, review of, 18: 19721
pinch discharge in, axial streams in Z, 18: 21531
plasma of, temperature measurements by spectroscopic method in, 18: 21406
radiosensitivy effects on *E. coli*, 18: 19681
reactions with argon, neon, and oxygen ions, method for studying inter-

changes in, 18: 20021
reactions with helium and oxygen ions in ionosphere, 18: 21092
reactions with helium and oxygen ions, cross sections and charge exchange rates for, 18: 20810
scattering of potassium chloride molecules by, 18: 20627(R) (NP-13815)
spectra in artificial aurora, 18: 21073
spectra in mixtures with oxygen, negative ions in afterglow, 18: 21093
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
thermodynamic properties at 64 to 300°K and 0.1 to 200 atm, 18: 21095(R) (NBS-8239)
yields in radiolysis of aqueous solutions of propanol containing nitrous oxide, 18: 20058

NITROGEN FIXATION
effects of irradiated nitrogen gas on, by Azotobacter, review of, 18: 19721

NITROGEN IONS
reactions with oxygen in ionosphere, thermal, 18: 21092
reactions with tungsten surfaces, electron ejection by, 18: 20777
sputtering on metals at 0.5 to 4 kev, momentum accommodation in, 18: 20782

NITROGEN ISOTOPES N-12
beta decay, 18: 21306
nuclear deformation parameters and energy levels for, 18: 21307

NITROGEN ISOTOPES N-13
helium-3 reactions (He-3,$p\gamma$) at 15.1 Mev, excitation and resonances in, 18: 21336
nuclear deformation parameters and energy levels for, 18: 21307

NITROGEN ISOTOPES N-14
alpha elastic scattering at 65 Mev, 18: 21260
deuteron reactions (d,α) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
energy level at 10.43 Mev, gamma decay scheme of, 18: 21261
energy levels, 18: 21336
neutron reactions (n,p) with, in atmosphere, 18: 20817
nuclear deformation parameters and energy levels for, 18: 21307
proton reactions (p,n) with, yields in, 18: 21336
triton reactions (t,α), (t,d), (t,p), and (t,t) at 1 to 2 Mev, differential cross sections for, 18: 21282

NITROGEN ISOTOPES N-15
nuclear deformation parameters and energy levels for, 18: 21307

NITROGEN ISOTOPES N-16
energy levels, 18: 21352
internal conversion coefficient for 120 kev transition, K, 18: 21352

NITROGEN OXIDES
effects on yields in radiolysis of aqueous 2-propanol, 18: 20058
radiolysis effects of nitrous oxide on hydroxyl radical yields in aqueous benzene, 18: 20047
uptake by human brain during anesthesia, 18: 19522

NITROGEN SYSTEMS
CO_2–N_2, temperature dependence of dielectric loss properties of, 18: 20627(R) (NP-13815)
methane–N, electron avalanche in discharges in, 18: 21491
N–H_2O, yields from d-c discharges in, 18: 20013
N–O, electric breakdown in plane-point and plane-wire gaps, 18: 20148
N–O, radiolysis of, ozone formation in, 18: 20095

NOBELIUM ISOTOPES No-256
fission half life of, spontaneous, 18: 21183 (JINR-P-1580)

19-NORANDROSTENOLONE
phenyl propionate, protective effects of, against x radiation in rats, 18: 19779

NRU REACTOR
poisoning by xenon, reduction of shutdown time from, 18: 21687

NUCLEAR CHEMISTRY
research programs in, at MIT, 18: 19837(R) (MIT-905-1)

NUCLEAR EMULSIONS
electron energy losses from ionization in, 18: 20391
meson (K^-) interactions at 1.5 Bev/c in lithium-loaded, hyperfragment production in, 18: 20938
performance for alpha and proton detection and discrimination, 18: 20362
production and performance of silver halide precipitates as, 18: 20414
proton ranges in Ilford K-1, at 0.3 to 1.2 Mev, 18: 20372
sensitivity of silver bromide crystals in, 18: 20336 (NP-13851)
techniques for, for high-energy particle accelerators, 18: 20966
use in elastic scattering experiments at high energy, 18: 20897 (CERN-64-6(p.31-48))
use in high-energy interaction studies, 18: 20901 (CERN-64-6(p.125-42))

NUCLEAR ENGINEERING
electron-beam melting and welding in, 18: 20491

NUCLEAR HEATING PLANTS
use for water desalination, economic implications of, 18: 21665

NUCLEAR ISOMERS
half lives of, measurement in 1 to 10,000 μsec range, 18: 21249

NUCLEAR MAGNETIC RESONANCE
measurement of, noise suppression in, 18: 19995
shielding by neighboring atoms, 18: 21232
shielding constants for, in 2-, 3-, and 4-electron atoms and ions, 18: 21233

NUCLEAR MATERIALS MANAGEMENT
neutron radiography of irradiated fuel, 18: 20591

NUCLEAR MODELS
comparison of Davydov and rotation-vibration, 18: 21323
eigenstates of pairing-force Hamiltonian for many-boson system with N-body interaction in, 18: 21034
for binary-fission mechanisms, 18: 21186 (KR-64(Sect.II))
formulation of Independent-Pair, variational principal connection with, 18: 21330
nucleon binding energies, energy levels, and potentials for self-consistent, 18: 21358
of beryllium-9 nucleus, 18: 21349
properties of statistical, lectures on, 18: 21190 (KR-64(Sect.VII))
velocity-dependent potentials in, 18: 21223

NUCLEAR MODELS (COLLECTIVE)
properties of, lectures on, 18: 21189 (KR-64(Sect.VI))
properties of, lectures on, 18: 21191 (KR-64(Sect.VIII))
use in predicting excited states in sodium-23, 18: 21327

NUCLEAR MODELS (DROP)
performance for describing fission reactions, 18: 21194 (KR-64 (Sect.XV))

NUCLEAR MODELS (SHELL)
performance for describing fission reactions, 18: 21194 (KR-64 (Sect.XV))
properties of, lectures on, 18: 21188 (KR-64(Sect.V))
spectroscopy in the $1f_{7/2}$ shell, 18: 21275
spin-orbit interactions in, 18: 21192 (KR-64(Sect.IX))
use in nuclear structure theory, 18: 20972

NUCLEAR PARTICLES
detection and measurement using silicon detectors, energy resolution for, 18: 20395

NUCLEAR PHYSICS
book: *Hilbert Space with Nuclear Functions*, in German, 18: 21341
data simulation in, use of on-line computer for, 18: 21158 (BNL-7836)
research using thermal neutrons, advanced course on, 18: 21185 (KR-64)

NUCLEAR POWER
development in Europe, role of State in, 18: 21644(T) (AEC-tr-6385)
needs and prospects in Israel, 18: 21739
prospects and programs in Great Britain, 18: 21740

NUCLEAR POWER PLANTS
condenser design for surplus steam, 18: 21663(P)
design study of dual-purpose heavy-water, for sea water distillation, 18: 21632 (DP-866)
economic and technical risks in operation of, 18: 21645
economics of, method for analysis of, 18: 21656
reactor containers for, safety requirements for, 18: 21647

NUCLEAR QUADRUPOLE RESONANCE
detection of, equipment for, 18: 19994

NUCLEAR REACTIONS
analysis of pickup and stripping, 18: 21204 (LADC-6302)
angular momentum weight factors, 18: 21212 (PAN-445/VI)
cross sections for, approximation method based on R-matrix theory, 18: 21304
distributions from, measurement of angular, 18: 21250
invariant variables for n particles and phase-space volume element,

18: 21305
research progress on, 18: 21712(R) (NYO-10065)
resonances in photo-, width of giant, 18: 21206 (NP-13813)
spin-orbit interactions in stripping, 18: 21366
theory of photodisintegration, direct-interaction, 18: 21266
theory of, bibliography on, 18: 21353
unified theory of photo-, 18: 21364

NUCLEAR SPECTRA
analysis of, approximation methods and pairing forces in, 18: 21216

NUCLEAR STRUCTURE
axial asymmetry in, 18: 21225
effects on spectra of mesic atoms, 18: 21331
energy levels of nonaxial odd-mass nuclei, 18: 21180 (JINR-P-1574)
equilibrium parameters of light nuclei, 18: 21307
neutron shell configuration study for $23 \leq Z \leq 28$ nuclei from (p,d) reactions, 18: 21291
research progress on, 18: 21712(R) (NYO-10065)
spectroscopy in the $1f_{7/2}$ shell, 18: 21275
theory of, bibliography on, 18: 21353
use of nuclear shell theory in, 18: 20972

NUCLEAR THEORY
bibliography on, 18: 21353
classification of excited states of even-even nuclei, 18: 21303
comparison of the Davydov theory with the model of axial-symmetric top with rotation-vibration interaction for deformed e-e nuclei, 18: 21323
connection of Independent-Pair model with variational principals, 18: 21330
eigenstates of pairing-force Hamiltonian for many-boson system with N-body interaction in, 18: 21034
energy levels of even-even strongly deformed nuclei in region $228 \leq A \leq 254$, 18: 21178 (JINR-P-1568)
energy levels of nonaxial odd-mass nuclei, 18: 21180 (JINR-P-1574)
equilibrium parameters of light nuclei, 18: 21307
four-particle wave function in the SU(3) scheme, 18: 21215 (UJV-1002-63)
meson (μ) capture rates in 2s-1d nuclei, 18: 21277
multiple Coulomb excitation of rotational states of nonaxial even-even nuclei, 18: 21177 (JINR-P-1563)
necessity of axial asymmetry in some nuclei, 18: 21225
neutron beta-decay parameters in, 18: 21128 (KR-64(Sect.XXVI))
neutron half life in, 18: 21129 (KR-64(Sect.XXVII))
nucleon clusters in light nuclei, 18: 21247
nucleon-nucleon interactions inside light nuclei, 18: 21345
of direct photodisintegration, 18: 21266
research progress on, 18: 21712(R) (NYO-10065)
symmetry energy and isotopic spin dependence of single-particle potential in, 18: 21287
two-body tensor force and Pauli exclusion principle in nuclear matter, 18: 21344
unified, of photonuclear reactions, 18: 21364
vector gauge field unification, 18: 21060
velocity-dependent nucleon-nucleon potentials and saturation of nuclear matter, 18: 21223
width of giant resonances in heavy nuclei, 18: 21206 (NP-13813)

NUCLEI
antiparticle and particle scattering at high energies, differential cross sections for, 18: 21333
beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
beta decay of, lectures on theory of, 18: 21187 (KR-64(Sect.IV))
deuteron reactions (d,n) with, spin-orbit interactions in, 18: 21366
electron inelastic scattering by, nucleon pair-correlation functions from, 18: 21356
electron inelastic scattering by oriented, differential cross section for polarized, 18: 21181 (JINR-P-1575)
electron scattering at high energies, energy losses in, 18: 21302
energy levels of deformed even-even, two-quasiparticle, 18: 21178 (JINR-P-1568)
energy levels of even-even, multiple Coulomb excitation of rotational, 18: 21177 (JINR-P-1563)
energy levels of even-even, 18: 21303
energy levels of odd-odd, 18: 21180 (JINR-P-1574)
energy levels of odd, with small nonaxiality, 18: 21231
energy levels of $Z \geq 20$, shell description of, 18: 21275
energy levels of, approximations for, 18: 21216
fission of heavy, models and theories for binary, 18: 21186 (KR-64 (Sect.II))
fission of, neutron distributions from, 18: 21197 (KR-64(Sect.XVIII))
half lives of short-lived isomeric states of, 18: 21249
magnetic shielding of, by neighboring atom, 18: 21232
magnetic shielding constants for, of 2-, 3-, and 4-electron atoms, 18: 21233
meson (μ^-) radiative capture by, polarization in, 18: 21310
meson (μ) capture by 2s-1d, Nilsson model calculations of rate of, 18: 21277
models for, lectures on collective, 18: 21191 (KR-64(Sect.VIII))
models for, spin-orbit terms in, 18: 21192 (KR-64(Sect.IX))
modulation of heavy cosmic, 18: 20813 (AD-434176)
neutron capture by, electron distributions from, 18: 20332 (KR-64 (Sect.XII))
neutron capture by, gamma spectra from thermal, 18: 21193 (KR-64 (Sect.XIV))
neutron fission of, charge and mass distributions from thermal, 18: 21195 (KR-64(Sect.XVI))
neutron reactions (n,γ) with, gamma spectra from, 18: 20333 (KR-64 (Sect.XX))
neutron reactions with polarized, resonance effects in, 18: 21127 (KR-64(Sect.XXV))
neutron reactions (n,γ) with, gamma-gamma angular correlations from, 18: 21199 (KR-64(Sect.XXI))
neutron reactions (n,γ) with, polarization of photons from, 18: 21200 (KR-64(Sect.XXII))
neutron resonance spins in, method for determination of, 18: 21164 (CONF-481-36)
nucleon capture by, analysis of gamma spectra from, 18: 21202 (KR-64(Sect.XXXII))
nucleon clustering in light, effects on nuclear reactions, 18: 21247
nucleon interactions inside light, calculation of energy levels using, 18: 21345
nucleon scattering by, two-body formulation of problems in, 18: 21337
particle reactions with, angular distributions from, 18: 21250
photon reaction resonances in heavy, width of giant, 18: 21206 (NP-13813)
photon reactions (γ,N) with, unified theory for, 18: 21364
positron decay of, energy relations and forbidden character of, 18: 21227
potential at, electron-produced electrostatic, 18: 20744(T)
properties of very strange, 18: 21184 (JINR-P-1583)
proton scattering at small angles by, multiple effects in, 18: 21242
proton scattering at high energies, energy losses in, 18: 21302
proton spallation of emulsion, angular correlation of fragments in, 18: 21229
spectra of deformed even-even, comparison of Davydov theory with rotation-vibration model for, 18: 21323
symmetry energy and isotopic spin dependence of single-particle potential in neutron-excess, 18: 21287
two-body tensor force and Pauli exclusion principle in nuclear matter, 18: 21344
velocity-dependent nucleon-nucleon potentials and saturation of nuclear matter, 18: 21223
wave functions in s-d shell of, 4-particle, 18: 21215 (UJV-1002-63)

NUCLEI (CELLS)
radiation effects on, in Walker carcinomas, 18: 19699

NUCLEIC ACIDS
analysis for trace elements, activation, 18: 19892
radioinduced castration effects on, x, 18: 19731

NUCLEONICS
developments in, review of, 18: 19867

NUCLEONS
binding energies, energy levels, and potentials of, from self-consistent, model, 18: 21358
binding energy of ground-state three-body system of, upper and lower bounds of, 18: 21048
clustering in nuclei, effects on nuclear reactions, 18: 21247

electric charge radius of, 18: 20976
electromagnetic form factors of, Regge representation for, 18: 21009
interactions of pairs of, spin-orbit effects in, 18: 21192 (KR-64(Sect. IX))
interactions of, Regge poles in, 18: 20988
interactions with mesons (π), detection of final state in, 18: 20401
interactions with mesons (π), S-wave scattering lengths using N/D method for, 18: 20937
interactions with mesons (π), Regge trajectories for, 18: 20940
interactions with mesons (π), coupling constant on Regge trajectory for, 18: 20948
interactions with mesons (π) at 170 to 600 Mev, model for single meson (π) production in, 18: 20964
interactions with nucleons at 30 to 10^6 Bev, particle production in, 18: 20969
interactions with mesons (π), Regge poles in, 18: 20988
interactions with nucleons, meson (ω) coupling in, 18: 21001
interactions with hypersons (Λ), π-K resonance in, 18: 21003
interactions with mesons (π), resonances in, 18: 21004
interactions with electrons, quantum electrodynamics of, 18: 21014
interactions with mesons ($\bar{K}$), motion of poles in resonance, 18: 21016
interactions with mesons (K), S-wave, 18: 21020
interactions with nucleons inside light nuclei, use in calculation of energy levels, 18: 21345
interactions with nucleons, velocity-dependent potentials in, 18: 21223
interactions with nucleons, variational principal connection with Independent-Pair Model for, 18: 21330
interactions with mesons (π) at 17 Bev/c, 18: 20891 (AD-433625)
interactions with nucleons, amplitudes for, 18: 20913 (TID-20483)
interactions with hyperons, amplitudes for, 18: 20913 (TID-20483)
interactions with deuterons in three-body potential problem, integral equation for amplitude for, 18: 20930
interactions with mesons (π), resonances in, 18: 21005
motion in nonaxial oscillator potential, 18: 21307
pair-correlation functions from electron inelastic scattering by nuclei, 18: 21356
photoproduction on nuclei, unified theory for, 18: 21364
resonance (π p) at 1922 Mev, production in proton-proton peripheral collisions, 18: 20927
resonance models and symmetries of, octet and Sakata, 18: 20994
scattering by nuclei, two-body formulation of problems in, 18: 21337
structure of, from inelastic electron-deuteron scattering experiments, 18: 20945

NUCLEOPROTEINS
radiation effects on rabbit agglutinins, restoration effects of immune donor, 18: 19765

NUCLEOSIDES
phospho-, contents in organs of irradiated rats, 18: 19702

NUCLEOTIDES
origin in cell-free viral synthesis, 18: 21725(R) (TID-20437)
phospho-, contents in organs of irradiated rats, 18: 19702
radiation sorption from chromatographic eluants, continuous flow analyzer for recording ultraviolet, 18: 19870

NUTRIENTS
assimilation by plant roots from soil, effects of soil management practices on, 18: 19515 (NP-13796)
intestinal absorption of, effects of hookworm infection in man, 18: 21724(R) (TID-20404)

O

OAK RIDGE NATIONAL LAB., TENN.
bibliography of publications, reports, and papers from, 1963, 18: 21714 (ORNL-3300(Vol. 3))
programs of, engineering, fabrication, and yield support of, 18: 20134(R) (ORNL-TM-792)

OCEANOGRAPHY
physical, chemical, and biological observations in Sargasso Sea of Bermuda, 1960 to 1963, 18: 21711 (NYO-3140-1B)

OLEIC ACID
radiation effects on uptake of, by lipids in human bone marrow, 18: 19552(R) (NYO-2769-1)

ONTARIO (SUDBURY DISTRICT)
lead isotopic ratios in mine samples from, gas source mass spectrometry of, 18: 20203

OOGENESIS
radiation effects on Drosophila, x, 18: 19622

OPTICAL SYSTEMS
development for use as extension for borescope, 18: 20134(R) (ORNL-TM-792)
light pipes in scintillation detector, efficiency of, 18: 20399
light source design for, 18: 21717 (SC-R-64-119)

ORES
analysis for hafnium, thorium, titanium, and zirconium, simultaneously, spectrographic, 18: 19912

ORGANIC ACIDS
separation of phenolic, by thin-layer electrophoresis, 18: 21736(T) (SC-T-64-615)

ORGANIC COMPOUNDS
mass spectra of excess-kinetic-energy ions in, 18: 20026

ORGANIC COOLED REACTORS
coolants for, evaluation of aromatic petroleum fractions for use as, 18: 19836 (EUR-496.f)
design study of heavy-water-moderated 8300-Mw(t), for sea water distillation and power production, 18: 21632 (DP-866)
pool boiler design for study of additive effects on critical heat flux of polyphenyl coolant, 18: 21554 (NAA-SR-Memo-8061)

ORGANIC MODERATED REACTOR EXPERIMENT
coolant processing by vacuum flash distillation of high boilers for, 18: 21552 (NAA-SR-Memo-7545)
coolant purification by clay bed for, radiometric analysis of adsorbant saturation in, 18: 21553 (NAA-SR-Memo-7771)

ORGANS
radiation response of mammalian, proton, 18: 19812 (BNL-6966)

ORNL FAST BURST REACTOR
safety block stop for, 18: 20134(R) (ORNL-TM-792)

ORNL HIGH FLUX ISOTOPE REACTOR
fuel element tooling for, 18: 20134(R) (ORNL-TM-792)

OSMIUM ALLOYS
Os–Rh–Ti, superconductivity, 18: 21112

OSMIUM ISOTOPES
separation of, electromagnetic, 18: 20432

OSMIUM ISOTOPES Os-186
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)

OSMIUM ISOTOPES Os-188
energy level at 155 kev, g-factor of, 18: 21244

OXAZOLE, 2,5-DIPHENYL–
spectra of solutions of, beta and uv excitation, 18: 20046

OXAZOLE, 2,2'-*p*-PHENYLENEBIS[5-PHENYL-
spectra of solutions of, beta and uv excitation, 18: 20046

OXIDATION
measurement of alloy and metal, design of apparatus for, 18: 20480

OXIDES
emittance of coatings of, 18: 20565

OXONIUM IONS
isotope effects on vibration frequencies of initial and transitional states of, 18: 19951

OXYGEN
balance in brain and marrow in rabbits, effects of radioprotective compounds on paraaminopropiophenone, 18: 19801
chemical effects on photochemical production of amines, 18: 20081
compressibility of liquid, at boiling point, 18: 19929 (CONF-417-20)
density in lower ionosphere, 18: 21075
desorption from molybdenum surface by slow-electron impact, 18: 20641
determination in germanium, niobium, and titanium, comparison of activation and vacuum fusion methods, 18: 19922
determination in metals, activation, 18: 19886
determination in rare earth oxides and fluorides, 18: 19907
determination in sodium, amalgamations method for, 18: 19919
effects on radioinduced dominant lethality in Drosophila oocytes, 18: 19622
electric discharge in, theory of self-quenching, 18: 21475
electric discharge in, formative time lags in, 18: 21493
electron multiple scattering at 40 to 130 kev, linear displacement

distributions in, 18: 21316
impurity effects in potassium-sodium reactor coolant, 18: 21661
molecular dissociation by electrons, electron affinities from, 18: 19993
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
oxygen ion reactions with, 18: 20023 (TID-20510)
pinch discharge in, axial streams in Z, 18: 21531
radiation effects on consumption of, by rats, effects of adrenaline and atropine on, 18: 19742
radiation effects on consumption of, by rats, effects of insulin on x, 18: 19806
radiolysis of, formation of ozone in, 18: 20095
radiosensitivity effects on *E. coli*, 18: 19681
radiosensitivity effects of, mechanisms of, 18: 19692
radiosensitivity effects in mice, 18: 19800
reactions with helium, nitrogen, and oxygen ions in ionosphere, 18: 21092
reactions with helium and oxygen ions, cross sections and charge exchange rates for, 18: 20810
reactions with uranium dioxide, effects of halides on, 18: 19943
separation from potassium–sodium coolants by cold-trapping, 18: 21657
spectra in artificial aurora, 18: 21073
spectra in mixtures with carbon dioxide and nitrogen, negative ions in afterglow, 18: 21093
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)

OXYGEN IONS
concentrations in Stellarators (C), 18: 21378 (MATT-251)
density in lower ionosphere of O^-, O_2^-, and O_3^-, 18: 21075
reactions with argon and nitrogen, method for studying interchanges in, 18: 20021
reactions with hydrogen, nitrogen, and oxygen in ionosphere, 18: 21092
reactions with nitrogen and oxygen, cross sections and charge exchange rates for, 18: 20810
reactions with oxygen, 18: 20023 (TID-20510)
reactions with tungsten surfaces, electron ejection by, 18: 20777

OXYGEN ISOTOPES O-14
beta decay of, half life for, 18: 21306

OXYGEN ISOTOPES O-15
energy levels, 18: 21336
nuclear deformation parameters and energy levels for, 18: 21307

OXYGEN ISOTOPES O-16
alpha elastic and inelastic scattering at 65 Mev, 18: 21260
gamma reactions (γ,α) and $(\gamma,4\alpha)$ up to 24 Mev, 18: 21224
gamma reactions (γ,p) up to 45 Mev, cross sections for, 18: 21163 (CONF-481-4)
gamma reactions (γ,n) at 13 to 50 Mev, yields from, 18: 21308
gamma reactions (γ,n) with, neutron energy spectra from, 18: 21257
neutron reactions (n,p) with, optical model analysis of, 18: 21165 (CONF-490-1)
separation from oxygen-18 by thermal diffusion in carbon monoxide, 18: 20435

OXYGEN ISOTOPES O-18
determination in organic compounds, mass spectrographic, 18: 19837(R) (MIT-905-1)
energy levels of, calculation from nucleon interactions, 18: 21345
exchange between phosphorus acid and water, mechanism and rate of, 18: 19965
separation from oxygen-16 by thermal diffusion in carbon monoxide, 18: 20435

OXYGEN ISOTOPES O-19
energy levels, 18: 21352
internal conversion coefficient for 95 kev transition, K, 18: 21352

OXYGEN SYSTEMS
Ar–O, radiolysis of, ozone formation in, 18: 20095
He–O, radiolysis of, ozone formation in, 18: 20095
Kr–O, radiolysis of, ozone formation, 18: 20095
Ne–O, electric discharge in, cathode performance in, 18: 21456
Ne–O, radiolysis of, ozone formation in, 18: 20095
N–O, electric breakdown in plane-point and plane-wire gaps, 18: 20148
N–O, radiolysis of, ozone formation in, 18: 20095
O–Xe, radiolysis of, ozone formation, 18: 20095

OYSTER CREEK POWER REACTOR
economic analysis of construction and operation, 18: 21651

OZONE
radioinduced formation in oxygen and in oxygen mixtures with nitrogen and rare gases, 18: 20095
radiomimetic toxicity of, 18: 19538
reactions with nitrosylruthenium nitrato complexes in nitric acid solutions, 18: 19924 (AERE-R-4537)

P

PACIFIC OCEAN
cesium content in, comparison of Atlantic and Pacific Oceans with, 18: 20220

PACKAGING
radiation effects on amounts of extractables from food, 18: 19889

PAIR PRODUCTION
electron, in electron reactions with aluminum, 18: 21311
electron, in electron reactions in lead, 18: 21334
electron, in relativistic electron reactions in media, 18: 20984

PALLADIUM
corrosion by cesium at 750°C, 18: 20873
stacking-fault energy, 18: 20550

PALLADIUM ALLOYS
Co–Pd, corrosion by cesium at 750°C, 18: 20873
Ni–Pd, corrosion by cesium at 750°C, 18: 20873
Pd–Rh–Ti, superconductivity, 18: 21112

PALMITALDEHYDE
synthesis of tritium-labeled, 18: 20025

PALMITIC ACID
radiation effects on uptake of, by lipids in human bone marrow, 18: 19552(R) (NYO-2769-1)
radiation effects on rabbit metabolism of carbon-14-labeled, x, 18: 19665

PANCREAS
radiation effects on hamster, x, 18: 19672

PARAFFIN
neutron attenuation by, from 14-Mev source, 18: 19821

PARASITES
effects of hookworm infection on intestinal absorption of nutrient and blood picture in man, 18: 21724(R) (TID-20404)

PARATHYROID GLANDS
polonium-210 distribution in rat, 18: 19542

PARTICLE STATISTICS
many-fermion systems, Meissner effect and flux quantization in, 18: 20667

PARTICLE TRACKS
analysis of bubble-chamber, microscopes for, 18: 20295
analysis of, using high-resolution scintillation detectors, 18: 20353
measurement in bubble chambers, error matrix for, 18: 20328 (BNL-7932)
measurement in ionization chambers, device for, 18: 20396
measurement of momentum and tangent of, in bubble chambers, error calculations for, 18: 20329 (BNL-7933)

PARTICLE TRAJECTORIES
calculation of, computer program for, 18: 20682 (TID-20563)
determination in axisymmetric magnetic fields, 18: 20645
determination in electromagnetic and magnetic fields in plasma, 18: 21521
in axisymmetric magnetic barriers, 18: 21449
ray-tracing method for ion-optical measurements, 18: 21022(P)

PARTICLES
diffusion in nonuniform atmosphere, 18: 20620
diffusion of, use of Poisson collections in calculation of, 18: 20442
impact shock waves in deuterium–tritium mixtures of accelerated, attainability of fusion temperatures in, 18: 21418
interactions of, collision integral calculations for, 18: 21707(R) (MLM-1177)
scattering by crystals, theory of momentum exchange in elastic neutral, 18: 21342

PATHOLOGY
radiation effects on dog, whole-body, 18: 19603

PEAS
effects of deuterium on root development in, 18: 19662

PEBBLE BED REACTORS

feasibility of gas-cooled, 18: 21658
PENTANE, 2,4-DIMETHYL-
radiolysis of, mechanism of hydrogen formation in, 18: 20057
PENTANE, 3-METHYL-
radiolysis of, mechanism of hydrogen formation in, 18: 20057
PENTANE, 2,2,4-TRIMETHYL-
radiolysis of, effects of dose rate and intensity on yields from gamma, 18: 20079
2,4-PENTANEDIONE
solvent properties for thorium, 18: 20106
PEPSIN
radiation effects on, effects of oxygen on, 18: 19692
PERCHLORATES
determination of, spectrophotometric, 18: 19843 (IS-658)
PERCHLORIC ACID
hydrogen isotope fractionation in aqueous solutions of, 18: 19968
PEROVSKITES
dielectric breakdown and degradation in, 18: 20526(R) (RADC-TDR-63-269)
PEROXIDASES
radiation effects on mouse blood cell metabolism of, x, 18: 19730
PEROXIDES
diacyl, decomposition, 18: 19837(R) (MIT-905-1)
trans-4-*t*-butylcyclohexanecarbonyl, decomposition, 18: 19837(R) (MIT-905-1)
PEROXYDISULFATE IONS
reactions with substituted 2,3-dihydro-1,4-phthalazinediones, chemiluminescence in, 18: 21722 (TID-18810)
PERRHENATE IONS
reduction, 18: 20005
PERSONNEL
cancer mortality among uranium milling and mining, 18: 20256
performance evaluation system for machining, 18: 21731 (Y-1461)
public health, during nuclear disaster, 18: 20252
radiation effects on urinary excretion of amino acids in, 18: 19638
radiation injury to right hand of, during handling of emitting x-ray tube, 18: 19706
radiation protection of, regulations for, 18: 20242
training ML-1 operating, 18: 21655
PERTECHNETATES
use of technetium-99m-labeled, for organ scanning, 18: 19814 (CONF-453-1)
PERTURBATION THEORY
cutoff procedures in, for scattering from strongly singular potentials, 18: 21049
equilibrium, initial correlations in approach to, 18: 21030
formulation of dynamic laws in the quantum theory of fields, 18: 21023 (NP-13878)
gauge invariance of, for spin-orbit coupling of force centers, 18: 21705(R) (IITRI-1184-12)
of molecular hydrogen, 18: 20743
Regge poles in, 18: 20997
use in derivation of Green's function for iterated Dirac equation, 18: 21027
PETROLEUM
evaluation of aromatic fractions of, for use as organic reactor coolants, 18: 19836 (EUR-496.f)
use in power plants, radioactivity in atmosphere from, 18: 20265
PHENANTHROLINE COMPLEXES
with cobalt, sorption by silicon oxide, 18: 19898
PHENOL
analysis for oxygen-18, mass spectrographic, 18: 19837(R) (MIT-905-1)
PHENOLS
separation by thin-layer electrophoresis, 18: 21736(T) (SC-T-64-615)
PHENYL ETHER
biphenyl–phenyl ether, neutron age in, 18: 21138
PHONONS
interactions with electrons, field theory of, 18: 21066
PHOSPHATASE ACTIVITY
radiation effects on, in carcinoma cells, 18: 19701
PHOSPHATASES
radiation effects on activity of, in adrenal glands of guinea pigs, 18: 19710
PHOSPHATE ROCKS
rare earth content and relative abundances in, 18: 20202
PHOSPHATIDES
protective effects against liver function disturbances in radiotherapy of tumors, 18: 19720
PHOSPHORIC ACID
electrolysis of ortho-, transference numbers in, 18: 20010
H_3PO_4–H_2SO_4, voltammetry of cerium, chromium, manganese, and vanadium in, 18: 19967
PHOSPHORIC ACID, ALKYL ESTERS
di(2-ethylhexyl)-, scintillation quenching, 18: 20352
solvent properties for cerium, lanthanum, and praseodymium, 18: 20109
PHOSPHOROUS ACID
oxygen-18 exchange between water and, mechanism and rate of, 18: 19965
PHOSPHORS
alpha and electron excitation of plastic pulse-height ratios for, 18: 20408
luminescence pulses from plastic, detection of pile-up in, 18: 20296
magnetic field and optical radiation effects on semiconducting, device for measuring, 18: 20307
performance of liquid, effects of experimental conditions, temperature, and oxygen on, 18: 20335 (NP-13840)
radioinduced luminescence in, analysis of relaxation processes in, 18: 20078
resonance in liquid substituted, steric inhibition of, 18: 20036
scintillation decay time of plastic, 18: 20343 (UCRL-11147)
PHOSPHORUS
content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)
determination in lubricants, computer routine for activation, 18: 19918
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination of, activation method using fast neutrons, 18: 19850 (TID-20472)
isotope exchange with phosphorus trichloride, 18: 20091
radioinduced reactions of white, with carbon tetrachloride, gamma and neutron, 18: 20091
PHOSPHORUS CHLORIDES
isotope exchange with white phosphorus, 18: 20091
PHOSPHORUS ISOTOPES P-31
deuteron reactions (d,*a*) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
PHOSPHORUS ISOTOPES P-32
beta decay of, polarization of electrons in, 18: 21324
content in blood plasma of cows and goats, method for establishing, 18: 19541
content in stratosphere, production mechanisms for, 18: 21080
determination in mixtures with carbon-14 or tritium, conditions for two-channel liquid scintillation, 18: 19873
effects on blood cells in chronic leukemia, 18: 19789
exchange between white phosphorus and phosphorus trichloride, 18: 20091
incorporation in thiophosphoric esters, 18: 20024
therapy for polycythemia blood volume changes after, 18: 19661
PHOSPHORUS ISOTOPES P-33
content in stratosphere, production mechanisms for, 18: 21080
PHOSPHORUS OXIDES
Nb_2O_5–P_2O_5, crystal structure of tetragonal phases in, 18: 19942
P_2O_5–Ta_2O_5, crystal structure of tetragonal phases in, 18: 19942
PHOTOELECTRIC EFFECT
cross sections at 0.2 to 2 Mev, K-shell, 18: 20753
measurement in neon at 80 to 600 A, instrumentation for, 18: 20728 (AD-412421)
polarization correlations at 0.2 to 2 Mev for K-shell, 18: 20754
PHOTOFISSION
delayed gammas in, at a few μsec to 10 sec following fission, 18: 21298
PHOTOGRAPHIC FILM
preparation of, radioactivity monitoring in industrial, 18: 20251
scanning bubble chamber, development of equipment for, 18: 21712(R) (NYO-10065)

PHOTOGRAPHY
use of spark, for measuring flow velocities of heated gases, 18: 20188
PHOTOMETERS
design of continuous flow, for ultraviolet absorption in chromatographic eluants, 18: 19870
PHOTOMETRY
developments in absorption and emission flame, review of, 18: 19863
PHOTOMULTIPLIER TUBES
performance characteristics of C-70045A high-speed, 18: 20343 (UCRL-11147)
PHOTON SHOWERS
production in lead, bubble chamber measurements of, 18: 20669
production in lead, Monte Carlo calculations of, 18: 21322
PHOTONS
absorption in gas discharges, coefficient for, 18: 21474
electromagnetic interactions of Yang-Mills field, 18: 21062
interactions with free electrons in condensed media and plasma, "photon drag" effect in, 18: 21407
interactions with electrons in plasma, kinetic theory of, 18: 21411
interactions with electrons in K-shell at 0.2 to 2 Mev, 18: 20753
interactions with electrons in K-shell or 0.2 to 2 Mev, polarization correlations in, 18: 20754
polarization in meson (μ^-) radiative capture by nuclei, 18: 21310
production of, fib theory of, 18: 20719
reactions (γ,N) with nuclei, unified theory for, 18: 21364
reactions with atoms, excitation and ionization in, 18: 20770
reactions with heavy nuclei, giant resonance in, 18: 21206 (NP-13813)
Regge poles in perturbation theory for electromagnetic interactions, 18: 20997
transport equations for, computer program for, 18: 21123 (GA-4972)
PHOTOSYNTHESIS
activity during Euglena mitosis, 18: 21721 (TID-18753)
1,4-PHTHALAZINEDIONES
chemoluminescent oxidation of substituted, by potassium peroxydisulfate, 18: 21722 (TID-18810)
PHYSICS
Mössbauer effect in solid-state, review on, 18: 19998
research in, use of computers as data-handling systems in, 18: 21699 (BNL-7841)
spectrometry in, review of light absorption, 18: 19860
PHYSIOLOGY
radiation effects on Mimosa, x, 18: 19574
PIGMENTS
effects of fundus, on radiosensitivity of rabbit eye, 18: 19547(R) (AMRL-TDR-63-71)
formation of melanin in mammals, effects on nervous response, 18: 21700 (BNL-7855)
PILOCARPINE
effects on iodine-131 secretion in thyroidectomized guinea pigs, 18: 19528
PINCH EFFECT
decay of, in helium and xenon, 18: 21421
electric breakdown phenomena in theta, 18: 21530
electron densities in theta, 18: 21529
electron density and temperature in theta, 18: 21526
electron density and energy in Z, measurement of, 18: 21532
electron runaway in toroidal, 18: 21533
hydrogen spectral emission in theta, 18: 21528
in gases under high pressure, 18: 21419
plasma behavior in linear high-current, 18: 21534
plasma containment in hard-core, by shock waves, 18: 21523
plasma deformation and drift in theta, 18: 21402
plasma electric breakdown in theta, 18: 21525
plasma production in Z, on metallic foils, 18: 21537
plasma streamers in Z, axial, 18: 21531
properties of theta, model for, 18: 21527
stability of diffuse, role of compressibility in, 18: 21416
stability of linear, under finite axisymmetric disturbances, 18: 21538
PIPERIDINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
PIPES
stress analysis of mixing tee for sodium reactor coolant, thermal, 18: 21567 (NAA-SR-Memo-7485)
PITUITARY GLAND
polonium-210 distribution in rat, 18: 19542
radiotherapy using yttrium-90 seeds, 18: 19824
PLANETS
atmosphere of Venus, model for, 18: 20627(R) (NP-13815)
PLANT CELLS
effects of heavy ions on, 18: 19571
photosynthetic activity in Euglena, 18: 21721 (TID-18753)
uptake of tritium-labeled arginine by *Vicia faba* root, 18: 19518 (BNL-7007)
PLANTS
antimony-125 content, 18: 19516
autoradiography and radioassay of, methods for, 18: 19856
cell-free viral synthesis by bean, 18: 21725(R) (TID-20437)
cesium-137 and strontium-90 in Lapland, 18: 20213
effects of water movement on ion movement into root xylem of tomato, 18: 21723 (TID-18877)
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
fallout uptake by, in England, 18: 20208 (AERE-R-4415)
fission product uptake by, from soil, 18: 19515 (NP-13796)
iodine-131 content of green leafy vegetables in Germany, fall 1962, 18: 19810
nuclear installations act for British, 18: 20247
radiation effects on genetics of Tradescantia, model for relation of, to LET, 18: 19573
radiation effects on nicotiana, seed-exposure, 18: 19690
radioinduced growth aberrants in jute, beta and x, 18: 19725
radioinduced reactions in Mimosa, x, 18: 19574
PLASMA
acceleration in Hall propulsor, MGD characteristics of, 18: 21391
accelerator for, construction of crossed-field, 18: 21442
accelerator for, theory of cross-field, 18: 20129 (ARL-64-29)
atom and electron densities in r-f discharge, measurement of, 18: 21512
behavior in h-f discharge, resonant, 18: 21515
Brownian motion in, bivariate distribution function for, 18: 21388 (TID-20491)
charge transport in two-temperature, mathematical analysis of, 18: 21439
charged particle energy gain by reflection from r-f field in, 18: 21520
charged particle orbits in electromagnetic and magnetic fields in, 18: 21521
charged-particle currents and temperatures in cesium and mercury, 18: 21438
charged-particle motion in, with constant homogeneous magnetic field, 18: 21383 (NP-13852)
configuration of solar, during solar flare, 18: 20814 (AD-434540)
containment by electric fields in glow discharges, 18: 21463
containment by h-f electric fields, 18: 21518
containment in cusp fields, interface shape at cusps in, 18: 21387 (NYO-10435)
containment in glow discharges, mechanisms of, 18: 21462
containment in hard-core pinch by shock waves, 18: 21523
containment in magnetic configurations with multipole stabilization, 18: 21414
containment of, water-cooled solenoid for, 18: 21539
cyclotron radiation from, single-particle, 18: 21417
density determination from hydrogen spectral lines, computer programs for, 18: 21369 (ATN-64(9233)-8)
density fluctuations and rotation in longitudinal field, 18: 21504
density of low-temperature, self-consistent potential for, 18: 21423
diagnostics of, by optical spectra analysis, 18: 21497
diagnostics of, relation to cathode thermionic emission, 18: 20842
diffusion across magnetic fields, 18: 21389 (TID-20509)
diffusion of weakly ionized magnetic, turbulent, 18: 21425
electric breakdown in theta-pinch devices, 18: 21525
electric conductivity between electrodes in moving, 18: 20119 (ARL-64-5)
electric conductivity of, a-c, 18: 21380 (NASA-TM-X-50732)
electric conductivity of, h-f, 18: 21401
electric conductivity of, in magnetic field, pre-electrode potential variations in, 18: 20661

electric discharge in, electric vs magnetic field hysteresis in, 18: 21403
electric fields in, frequency properties of quasi-potentials from h-f, 18: 21519
electric impedance characteristics of positive column of, 18: 21457
electric permittivity of glow discharge, measurement of, 18: 21458
electromagnetic wave propagation in cold, characteristics of, 18: 21381 (NASA-TN-D-2071)
electromagnetic wave propagation in, frequency limits to, 18: 21382 (NASA-TN-D-2273)
electromagnetic wave reflection from, at very long wavelengths, 18: 21441
electromagnetic wave instabilities in, in magnetic field, 18: 21446
electromagnetic wave scattering from thermal nonequilibrium, cross sections and number density fluctuations for, 18: 21420
electromagnetic wave scattering by, analysis of, 18: 21540
electron attachment and ionization coefficients for, measurement of, 18: 21470
electron beam interactions in, cathode space charge in, 18: 21453
electron beam reactions in, hose instability in, 18: 21541
electron density distributions in low-temperature, 18: 21465
electron density measurement in, method for, 18: 21384 (NP-13853)
electron distribution in, in external homogeneous magnetic field, 18: 21432
electron energy in radially increasing magnetic field, increases in, 18: 21499
electron losses in, ambipolar diffusion and recombination in, 18: 21433
electron motion in, 18: 21436
electron temperature effects in, in strong electric field, 18: 21447
electron temperature distribution in magnetic fields, 18: 21468
electron temperatures in thermal column of, inhomogeneous, 18: 21469
electron-photon interactions in, kinetic theory of, 18: 21411
energy losses from expanding, in vacuum with magnetic field, 18: 21424
equilibrium of cylindrical, in space-periodic magnetic field, 18: 21434
flow in axial magnetic field, velocity of, 18: 21484
flow in transverse magnetic fields, velocity of, 18: 21485
free energy of infinite, electrostatic, 18: 21400
heating in transient discharges, ohmic, 18: 21522
hydromagnetic wave propagation in current-carrying column of, with nonuniform mass density, 18: 21385 (NP-13863)
hydromagnetic wave propagation in nonisothermal, 18: 21431
hydrothermomagnetic wave propagation in weakly inhomogeneous, 18: 21422
interactions of expanding cylindrical, with external magnetic field, 18: 21427
ion temperature measurement in, method for, 18: 21384 (NP-13853)
kinetic theory of weakly coupled, 18: 21376 (MATT-238)
lifetime in radially increasing magnetic field, increases in, 18: 21499
magnetohydrodynamic flow in channels, energy conversion with Hall currents in, 18: 21410
magnetohydrodynamic rotation of, 18: 21443
metallic, Fermi-liquid effects in reflection properties of, 18: 21047
microwave diagnostics, 18: 21368 (AFCRL-63-161)
microwave diagnostics of rocket motor hypersonic plume containing cesium and potassium, 18: 21399
microwave emission by hydrogen, 18: 21394
microwave propagation in waveguide of, 18: 21444
microwave transmission by cylinder of, 18: 21372 (CLM-R-34)
motion of dense clusters of, in toroidal magnetic field, 18: 21437
motion of magnetically confined cylinder of, 18: 21538
oscillational interactions with Penning gage conduction mechanisms 18: 21507
oscillations in anisotropic, stability of Rayleigh-Taylor-type, 18: 21390 (UCRL-7330)
oscillations in d-c discharge, 18: 21460
oscillations in heterogeneous media, 18: 21440
oscillations in low-pressure thermionic cells, 18: 20840
oscillations in, from electric current pulse, 18: 21461
oscillations of heterogeneous, damping of, 18: 21429
photon-electron interactions in, "photon-drag" effect in, 18: 21407
pinch discharge in, electron density and temperature in theta, 18: 21526
pinch discharge in, model for theta, 18: 21527
pinch discharge in, behavior in linear high-current, 18: 21534
pinch discharges in, deformation and drift in theta, 18: 21402
pressure variations and thermal conductivity in arc column of, in magnetic fields, 18: 21483
production and spectra of magnetically compressed dense, 18: 21421
production by photolysis, 18: 21524
production in arc heaters, effects of vortex flow on, 18: 21393
production in disruptive discharge, mechanism for, 18: 21494
production in pinch devices, effects of high initial pressure on, 18: 21419
production in Z pinch on metal foils, 18: 21537
production of fully ionized, methods for, 18: 21496
production of low-temperature argon, using electric discharges, 18: 21498
properties of low-voltage thermionic diode, 18: 20851
properties of r-f discharge, 18: 21517
properties of rotating, in crossed fields, 18: 21501
properties of weakly ionized helium, 18: 21375 (MATT-236)
radiation cooling of, after shock-wave heating, 18: 21408(T)
radiation emission by discharge, resonance, 18: 21464
research programs on, 18: 21373 (EUR-495.i)
shock waves in, microwave studies of electrically driven, 18: 21448
solid-state phenomena in, 18: 21395
spectral line broadening in, generalization of statistical theory on, 18: 21405
spectral line broadening of aluminum, tin, and silicon ions in strongly ionized, 18: 21409(T)
stabilities in conical accelerators, Rayleigh-Taylor, 18: 21428
stability in crossed fields, l-f, 18: 21505
stability in magnetic field, effects of conductivity on, 18: 21430
stability in reflex discharge, 18: 21503
stability integral gradients for, method for determining, 18: 21413
stability of a-c positive column of, 18: 21412
stability of diffuse pinched, role of compressibility in, 18: 21416
stability of gyro-dominated, two-stream, 18: 21506
stability of, critical magnetic field for, 18: 21398
stability of, kinetic theory of flute, 18: 21371 (CLM-R-33)
stabilization of dissipative modes, ion gyro-radius effects on, 18: 21415
striations in neon discharge, 18: 21451
structure of r-f, helical, 18: 21516
temperature measurements in nitrogen, spectroscopic method for heavy particle, 18: 21406
theory of turbulent, in magnetic field, 18: 21426
thermal conductivity and approach to equilibrium, 18: 21397
thermodynamic functions of fully ionized homogeneous, theory for determining, 18: 21450
velocity of, measurement of rotational, 18: 21500
wave excitation in compressible cylinder, coupled electro-acoustical, 18: 21396
wave motion in collision-free, finite-amplitude compression, 18: 21386 (NYO-10434)
wave propagation in magnetic fields, collisional damping of, 18: 21404

PLASMA JETS
motion in magnetic fields, 18: 21486
motion in magnetic fields in air, deflection in, 18: 21487
use in high-temperature research furnaces, 18: 20157

PLASTICS
fillers for, evaluation of zirconia fibers as, 18: 21709(R) (MLM-1179)
radiation stability of, guide to, 18: 20582(NIRL/R/58)

PLATES
neutron albedo on, transport solution for, 18: 21134 (TID-20540)

PLATINUM
corrosion by dry and wet air at 2200 to 3000°F, activation energy for, 18: 20445(R) (AD-434441)
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)
diffusion in copper and tantalum, concentration gradients of, 18: 20512 (ASD-TDR-62-7(Pt.II))
reflectance of crystalline, 18: 19837(R) (MIT-905-1)
sputtering by rare gas ions at 20 to 1000 ev, mass dependence of, 18: 20786
stacking-fault energy, 18: 20550

PLATINUM ALLOYS
Pt–Rh, corrosion by dry and wet air at 2200 and 2550°F, 18: 20445(R)

(AD-434441)
Pt–Rh–Ti, superconductivity, 18: 21112
Pt–Sn, tin-119 Mössbauer effect in, 18: 20007
Pt–Ta, phase studies, 18: 20512 (ASD-TDR-62-7(Pt.II))
PLATINUM ISOTOPES Pt-192
nuclear axial asymmetry in, 18: 21225
PLATINUM ISOTOPES Pt-199
beta decay of, gold-199 energy levels from, 18: 21243
PLATINUM OXIDES
thermal decomposition, 18: 19837(R) (MIT-905-1)
PLOWSHARE PROJECT
production of heavy isotopes in, 18: 20126 (UCRL-7770)
PLUTONIUM
analysis for uranium by controlled-potential coulometry and spectrophotometry, 18: 21707(R) (MLM-1177)
fabrication of fuel elements of, electron-beam welding for, 18: 20492
oxidation state in aqueous media, determination of, 18: 19896
reactions with ferric hydroxide, precipitation, 18: 19915
separation from americium-241 by ion exchange, 18: 20459(T,R) (EURAEC-954)
separation from aqueous media by solvent extraction using lanthanum fluoride and TTA, 18: 19896
separation from iron by precipitation with ferric hydroxide, 18: 19915
separation from plutonium–iron alloys by electrorefining, 18: 20099 (LA-3029)
separation from uranium by ion exchange and solvent extraction, 18: 21707(R) (MLM-1177)
specific heat at high temperatures, 18: 20593
PLUTONIUM ALLOYS
Al–Pu, reactivity of fuel elements of, 18: 21613 (HW-79960)
Fe–Pu, separation of plutonium from, by electrorefining, 18: 20099 (LA-3029)
Ga–Pu, thermoelectric power of phase transformations in, 18: 20527 (RFP-351)
PLUTONIUM ARSENIDES
formation, 18: 20450(R) (BMI-1661(Del.))
PLUTONIUM CARBIDES
analysis for combined and free carbon, 18: 19902
preparation, 18: 21698(R) (ANL-6860)
thermal expansion coefficient at temperatures up to 900°C, linear, 18: 20522 (LADC-5788)
PuC–UC, preparation, 18: 21698(R) (ANL-6860)
PuC–UC, production for use as fast reactor fuel, 18: 20507(P)
PuC–UC, production for use as fast reactor fuel, 18: 20508(P)
PuC–UC, thermal expansion coefficient at temperatures up to 900°C, linear, 18: 20522 (LADC-5788)
PLUTONIUM ISOTOPES Pu-236
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
PLUTONIUM ISOTOPES Pu-238
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
half life, 18: 21707(R) (MLM-1177)
PLUTONIUM ISOTOPES Pu-239
effects on rat liver lysosomes, 18: 19669
fission of, relative yields of long-lived radioisotopes from, 18: 19516
neutron Doppler coefficient of, calculation of, 18: 21593 (APDA-157)
neutron effective cross sections, 18: 21167 (CRRP-1191)
neutron fission of, delayed gamma spectra from fast, 18: 21296
neutron fission resonance integral, 18: 21166 (CRRP-1183)
neutron total cross sections, 18: 21203 (LA-1493)
removal from rats, effectiveness of DTPA for delayed, 18: 20236(R) (PG-Report-565)
thermodynamic properties at 298 to 5000°K, 18: 19956
PLUTONIUM ISOTOPES Pu-240
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
neutron Doppler coefficient of, calculation of, 18: 21593 (APDA-157)
neutron resonances, 18: 21156 (AEEW-R-351)
PLUTONIUM ISOTOPES Pu-241
neutron fission resonance integral, 18: 21166 (CRRP-1183)
PLUTONIUM ISOTOPES Pu-242
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
PLUTONIUM ISOTOPES Pu-244
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
PLUTONIUM NITRIDES
oxidation in nitrogen–oxygen, 18: 20450(R) (BMI-1661(Del.))
PLUTONIUM OXIDES
neutron Doppler coefficient for, in fast reactors, 18: 21593 (APDA-157)
PLUTONIUM(IV) OXIDES
dissolution by hydrofluoric acid, 18: 20459(T,R) (EURAEC-954)
BeO–PuO_2–ThO_2, development for pebble-bed reactors, 18: 21658
PuO_2–UO_2, development and fabrication for reactor fuel elements, 18: 20460(T,R) (EURAEC-965)
PuO_2–UO_2, fabrication and testing, 18: 20459(T,R) (EURAEC-954)
PuO_2–UO_2, radiation effects on, 18: 20459(T,R) (EURAEC-954)
PuO_2–UO_2, reactivity of fuel elements of, 18: 21613 (HW-79960)
PuO_2–UO_2, thermal properties, 18: 20459(T,R) (EURAEC-954)
PLUTONIUM PHOSPHIDES
formation, 18: 20450(R) (BMI-1661(Del.))
PLUTONIUM RECYCLE TEST REACTOR
fuel development, 18: 21698(R) (ANL-6860)
fuel elements for, reactivity of, 18: 21613 (HW-79960)
heat transfer and hydrodynamics in, 18: 21698(R) (ANL-6860)
PLUTONIUM SILICIDES
formation, 18: 20450(R) (BMI-1661(Del.))
PLUTONIUM SYSTEMS
C–Pu, phase diagram of, dilatometric studies on, 18: 20522 (LADC-5788)
PNEUMATIC SYSTEMS
design of air gun, 18: 20195(R) (SC-DC-64-383)
POLAND
decontamination of Vistula River water by Warsaw filtration plant, 18: 20229 (CLOR-23)
fallout monitoring, 1962, 18: 20211 (CLOR-24)
radiation protection in industrial flaw detection laboratories in, 18: 20259
radiation protection during operation of large radiation sources in, 18: 20260
strontium-90 content in diet, 1953 through 1961, 18: 20235 (NP-13868)
POLAROGRAPHY
catalytic hydrogen currents in, 18: 19908
POLARONS
energy in ionic crystals, Monte Carlo method for calculating, 18: 21737(T) (UCRL-Trans-1040(L))
POLONIUM ISOTOPES Po-208
decay, 18: 21709(R) (MLM-1179)
decay and half life, 18: 21708(R) (MLM-1178)
half life, 18: 21707(R) (MLM-1177)
POLONIUM ISOTOPES Po-209
decay and half life, 18: 21708(R) (MLM-1178)
half life, 18: 21707(R) (MLM-1177)
half life, 18: 21709(R) (MLM-1179)
POLONIUM ISOTOPES Po-210
content in urine of Japanese uranium miners, 18: 19916
distribution in hypophysis, thyroid, and parathyroid glands in white rats, 18: 19542
half life, 18: 21708(R) (MLM-1178)
POLYCYTHEMIA
phosphorus-32 therapy for, blood volume changes after, 18: 19661
POLYMERIZATION
radioinduced, of methylacetylene and phenylacetylene, 18: 20052
radioinduced, of organic monomers, 18: 20450(R) (BMI-1661(Del.))
POLYMERS
book: *Crystalline Olefin Polymers*, 18: 20034
radiation effects on properties of, 18: 20089
radioinduced discharge of static charges on, 18: 20068
radioinduced production of graft, 18: 20096(R)
viscoelasticity of, review, 18: 20531 (UCRL-7255)
POLYPHENYLS
analysis for trace elements, x-spectrographic, 18: 19844 (ISPRA-455)
distillation of reactor-coolant, by vacuum flash distillation for impurity removal, 18: 21552 (NAA-SR-Memo-7545)
performance as reactor coolant, effects of additives on saturated pool boiling in, 18: 21554 (NAA-SR-Memo-8061)
substituted, steric inhibition of resonance in liquid, 18: 20036
POPULATIONS

analysis of Hiroshima and Nagasaki, for tumor incidence, 18: 19596
mutant gene evolution in, of Drosophila and Habrobracon, 18: 19506(R) (TID-20401)
radiation effects on human, low-dose, 18: 19625
POROUS MATERIALS
fabrication of barriers of, for isotopic separation of gases, 18: 20437(P)
POSITRONIUM
energy levels of, splitting of ground-state, 18: 20909 (JINR-P-1572)
POSITRONS
annihilation in cerium, gadolinium, and ytterbium for electron structure measurements, 18: 20552
emission by nuclei, conditions for, 18: 21227
interactions with electrons, cross sections for mesons (π^-) and (π^+) production in, 18: 20986
POTASSIUM
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
determination in nucleic acids, activation, 18: 19892
effects on cesium fuel for ion engines, 18: 20626(R) (NP-13800)
electron structure, 18: 20548
flow of, heat transfer in two-phase, 18: 20171 (TID-7694(p.18-23))
heat transfer of boiling, forced- and natural-circulation, 18: 20160(R) (AD-423679)
heat transfer of boiling, forced- and natural-circulation, 18: 20166(R) (NP-13810)
performance as reactor coolant, evaluation of, 18: 20192
physical properties of liquid, review, 18: 20516 (EUR-599.d)
sorption by Dowex 50 X8 in ammonia, effects of anions on, 18: 19837(R) (MIT-905-1)
thermodynamic and transport properties of liquid and gaseous, at temperatures up to 2100°F, 18: 19926 (BATT-4673-FINAL)
thermodynamic properties of liquid and solid, 18: 20018
transport properties of liquid and solid, 18: 20018
POTASSIUM ALLOYS
K–Na, chemistry and impurity analysis of reactor-coolant, 18: 21661
K–Na, physical properties of liquid, review, 18: 20516 (EUR-599.d)
K–Na, purification by cold-trapping, 18: 21657
K–Na, vapor pressures and activities of sodium and potassium in, 18: 20569
POTASSIUM BROMATES
reactions with thorium oxinates, depolarimetric, 18: 20106
POTASSIUM BROMIDES
radiation effects on color centers in, prolonged low-temperature, 18: 20668
radiation effects on electric conductivity of, effects of impurities on x, 18: 20588
radioinduced color centers in crystals of, x, 18: 20040 (COO-1044-15)
POTASSIUM CHLORIDES
analysis for chlorine-38 and potassium-42, calculation method for, 18: 20069
crystal lattice vibrations of, eigenvectors for, 18: 21726 (TID-20487)
electron paramagnetic resonance and optical absorption of F-centers in, 18: 21705(R) (IITRI-1184-12)
electron spin double resonance studies of F centers in, 18: 20675
radiation effects on color centers in, prolonged low-temperature, 18: 20668
radiation effects on electric conductivity of, effects of impurities on x, 18: 20588
scattering of molecules of, by argon and nitrogen, 18: 20627(R) (NP-13815)
x-ray scattering cross sections, 18: 20035
Bi–LiCl–KCl, chemical state and distribution coefficient of copper in, 18: 19983
$PbCl_2$–KCL, radioinduced Cl_2 molecule-ion centers in, bleaching of, 18: 20038 (COO-1044-13)
POTASSIUM COBALT FERROCYANIDES
preparations and properties of granular, for use as ion exchange sorbent for cesium, 18: 20097 (CONF-179-1)
POTASSIUM CYANIDES
purification, 18: 20040 (COO-1044-15)
radioinduced color centers in crystals of, x, 18: 20040 (COO-1044-15)
POTASSIUM FERROCYANIDES
reactions with cerium, potentiometric, 18: 20106
POTASSIUM FLUORIDES
spectra of, simultaneous measurement of hyperfine structure, Stark effect, and Zeeman effect in, 18: 20762
LiF–KF–NaF, chronopotentiometry and voltammetry of iron in liquid, 18: 19966
POTASSIUM IODIDES
radioinduced F bands in, temperature dependence of growth rate of, 18: 20656
POTASSIUM IONS
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)
POTASSIUM ISOTOPES K-39
neutron reactions (n,p) with, optical model analysis of, 18: 21165 (CONF-490-1)
proton reactions (p,γ) at 6 to 15 Mev, differential cross sections and yields for, 18: 21363
POTASSIUM ISOTOPES K-40
decay of, gamma energy in, 18: 21273
POTASSIUM NITRATES
radiation effects on, 18: 20080
$CaNO_3$–KNO_3, effects on chloride association with silver, 18: 19975
$LiNO_3$–KNO_3, effects on chloride association with silver, 18: 19975
POTASSIUM OXIDES
additive effects on fabrication and properties of tungsten, 18: 20443(R) (AD-416199)
POTASSIUM PERRHENATES
rhenium(VI) reduction in, 18: 20005
POTASSIUM PLUTONIUM SULFATES
properties of dihydrate of, for use as primary calorimetric standard for plutonium, 18: 21707(R) (MLM-1177)
POTASSIUM THIOCYANATES
electric conductivity of, temperature dependence of d-c, 18: 19930 (COO-1044-12)
POWDERS
electromagnetic radiation reactions with, plasma production in, 18: 21524
POWER PLANTS
radioactivity in atmosphere from fossil-fuel, 18: 20265
POWER REACTORS
burnup calculations for, effects of effective cross-section value on, 18: 21654
coolant removal from upper plenum of 200-Mw(e) SGR, hydraulics of, 18: 21639 (NAA-SR-Memo-9241)
design for uniform thermal power distribution, 18: 21648
design of steam-cooled water-moderated, 18: 21662(P)
design of 1180-Mw(e) Wylfa, 18: 21649
development for propulsion of space vehicles, 18: 21678
economics of, method for analysis of, 18: 21656
effective cross section for, calculation of, 18: 21654
fuel element grapple and hold-down-latch development for SGR, 18: 21638 (NAA-SR-Memo-8266)
maximum credible accidents in, survey of, 18: 21647
shielding for, calculation of gamma and neutron attenuation in thermal, 18: 21636 (HW-72844)
use for water desalination, economic implications of, 18: 21665
POWER SUPPLIES
design of high-stability 1-ampere, for less than 15 v, 18: 20299
properties of Brayton-cycle, for space systems, 18: 21679
PRASEODYMIUM
compressibility at room temperature, 18: 20553
content and relative abundances in terrestrial materials, 18: 20202
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from cerium using bis(2-ethylhexyl) phosphoric acid, chromatographic, 18: 20109
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
PRASEODYMIUM ISOTOPES Pr-141
gamma reactions (γ,n) up to 30 Mev, cross sections for, 18: 21278
PRASEODYMIUM ISOTOPES Pr-142

decay of, radiochemical measurement of branching ratio in, 18: 19837(R) (MIT-905-1)
PRASEODYMIUM ISOTOPES Pr-143
metabolism by mice after inhalation in liquid aerosol, 18: 19544
production of carrier-free, by ion exchange and selective adsorption, 18: 20071
PRASEODYMIUM ISOTOPES Pr-144
beta decay of, circular polarization of gamma radiation following, 18: 21309
electron polarization in, method for measuring longitudinal, 18: 21339
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
PRASEODYMIUM NITRATES
separation by solvent extraction using TBP, calculation of cascade stagewise conditions for, 18: 20098 (IS-780)
solubility polytherms of systems with other ceric earths, 18: 20108
PRASEODYMIUM OXIDES
analysis for oxygen, 18: 19907
PREGNANCY
radiotherapy for cervical carcinomas followed by, radium and x, 18: 19565
PRESSURE
levels of sound from ultrasonic devices, 18: 21704 (HW-SA-3028)
PRESSURE DROP
in flow of steam–water mixtures in vertical tubes, 18: 20164 (EURAEC-1004)
in two-phase flow in circular and rectangular channels, 18: 20172 (TID-7694(p.24-34))
in vertical venturi in two-phase flow, 18: 20173 (TID-7694(p.35-6))
PRESSURE GAGES
description of absolute, for 1-torr range, 18: 20297
PRESSURE VESSELS
design and testing of prestressed concrete spherical, for containing explosions, 18: 20130 (LADC-5817)
design for reactor containment, 18: 21641 (NP-13793)
design of concrete and metal, for gas-cooled reactors, 18: 21576
fabrication of René-41, machining techniques for, 18: 20134(R) (ORNL-TM-792)
heating of arc-heater, 18: 20129 (ARL-64-29)
support design, 18: 21590(P)
PRESSURIZED WATER REACTORS
design of Consolidated Nuclear Steam Generator II, 18: 21667 (BAW-1280)
PROCESS HEAT REACTORS
design study of large dual-purpose heavy-water, for sea water distillation, 18: 21632 (DP-866)
PROLINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
PROLINE, HYDROXY-
uptake of labeled, by isolated intact rat diaphragm, effects of insulin on, 18: 19540
PROMETHIUM
electron binding energies in, 18: 20766
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from americium and samarium by ion exchange, 18: 21707(R) (MLM-1177)
separation from americium, 18: 21708(R) (MLM-1178)
PROMETHIUM ISOTOPES Pm-147
determination in urine by liquid scintillation counting, 18: 19875
energy levels of, from Coulomb excitation, 18: 21350
production of carrier-free, by ion exchange and selective adsorption, 18: 20071
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
PROMETHIUM ISOTOPES Pm-148
decay scheme, 18: 21262
1,2-PROPANEDIAMINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
2-PROPANOL
radiolysis of deaerated aqueous solutions of nitrous oxide-containing, yields in, 18: 20058
spectra of uranium tetrachloride in, absorption, 18: 19935 (TID-18814)
2-PROPANONE, AMINO-, *N,N*- DIACETIC ACID
complexes with metal ions, dissociation and stability constants of, 18: 19946
preparation, 18: 19946
PROPENE
formation by carbon atom reactions with ethane, mechanism of, 18: 20022 (CONF-322-10)
PROPENE, HEXAFLUORO-
nuclear magnetic resonance of sorbed, on alumina, temperature dependence of, 18: 20632 (TID-18689)
PROPENE, 2-METHYL- POLYMERS
radiolysis at 4 Mev, effects on infrared and ultraviolet spectra of, 18: 20065
radiolysis at 4 Mev, effects of additives on, 18: 20066
radiolysis of, yields of double bonds, fractures, and gases in, 18: 20064
PROPENE POLYMERS
radiation effects on properties of, 18: 20089
PROPIONAMIDE
acrylamide-propionamide, radiolysis of solid solutions of, yields of decomposition products in gamma, 18: 20094
PROPIONIC ACID, 2-MERCAPTO-
analytical use in photometric determination of molybdenum, 18: 19914
PROPIOPHENONE, p-AMINO-
effects on oxygen balance in bone marrow and brain of rabbits, 18: 19801
protective effects against x irradiation in dogs, 18: 19794
protective effects against x irradiation in dogs, 18: 19795
radioprotective effects of, mechanism for, 18: 19771
PROPORTIONAL DETECTORS
development of, review of, 18: 20406
performance characteristics of carbon dioxide-filled, 18: 20397
performance in counting neutron sources, effects of temperature on, 18: 21709(R) (MLM-1179)
resolution time, 18: 21709(R) (MLM-1179)
PROPULSION
ion, performance of potassium- and sodium-contaminated cesium fuel in, 18: 20626(R) (NP-13800)
nuclear, requirements and prospects of, for space vehicles, 18: 21678
performance of power-limited systems, effects of propellant stream velocity distribution on, 18: 20639
PROPYLAMINE
effects on oxygen balance in bone marrow and brain of rabbits, 18: 19801
PROPYNE
radioinduced polymerization of gamma, 18: 20052
PROTACTINIUM
separation from manganese by solvent extraction, 18: 20105
separation from uranium processing wastes, efficiency of ion exchange and solvent extraction for, 18: 20105
PROTAMINES
effects on mouse tumor cells, 18: 21732(T) (ANL-Trans-7)
PROTEINS
bis(2-guanidoethyl) disulfide bonding to, 18: 19773
radiation effects on rat blood serum, temperature effects on, gamma, 18: 19642
radiation effects on mouse spleen, x, 18: 19744
radiation effects on rat kidney and skeletal muscle, gamma, 18: 19745
radiation effects on rat serum, x, 18: 19754
PROTON BEAMS
energy of, for meson factory, 18: 21213 (TID-20440)
PROTON PAIRS
annihilation of, (π^+-π^-) interaction resonance in, 18: 20894 (BNL-7969)
PROTON SOURCES
design for synchrotrons, 18: 20690
development of hydrogen discharge as, 18: 20155
PROTON SPECTROMETERS
performance of, using silicon surface barrier detectors, 18: 20355
PROTONS
attenuation by silicon semiconductor detectors, 18: 20376
chemical effects on toluene at 0.5 to 1.8 Mev, relation of linear energy

transfer and yields in, 18: 20055
detection and measurement using nuclear emulsions, 18: 20362
effects on malignant tissue, 18: 19812 (BNL-6966)
energy transfer in silicon at 0.5 to 1.5 Bev, 18: 20410
interactions of, equipment for detecting polarization effects in, 18: 20383
interactions with protons, detection of final state in, 18: 20401
interactions with neutrons at 128 Mev, triple-scattering parameter for, 18: 20933
interactions with polarized neutrons at 126 Mev, polarization in, 18: 20934
interactions with mesons (π^-) at 1.4 to 3.0 Bev/c, tests of one-pion-exchange model for, 18: 20935
interactions with neutrons and protons, Regge trajectories for, 18: 20936
interactions with mesons (π^-) at 10 Bev/c, analyses of 4-prong, 18: 20951
interactions with antiprotons, unitary symmetry model for, 18: 20953
interactions with mesons (K) at 2.00 Bev/c, elastic, 18: 20954
interactions with mesons (K^-) at 1.80 and 1.95 Bev/c, hyperon (Ξ^-) production in, 18: 20959
interactions with mesons (π^-) at 10 Bev/c, meson (f^0) production in, 18: 20960
interactions with mesons (K) and (π), unitary symmetry model for, 18: 20962
interactions with mesons (π^-) at 170 to 600 Mev, single meson (π) production in, 18: 20964
interactions with protons, nuclear emulsion study of, 18: 20966
interactions with protons at 657 Mev, phase-shift analysis of, 20992
interactions with deuterons, polarization in elastic, 18: 21008
interactions with mesons (π^-) at 374, 417, and 454 Mev, neutron differential distributions in inelastic, 18: 21011
interactions with mesons (π^-) at 2.1 Bev/c, meson (ω) and (ρ) interference in, 18: 21017
interactions with mesons (K^-), Y_0^* resonance in, 18: 21020
interactions with deuterons, singularity in, 18: 20903 (JINR-E-1581)
interactions with deuterons, use of on-line computer for data simulation in, 18: 21158 (BNL-7836)
interactions with protons at high energies, Regge pole analysis of elastic, 18: 20896 (CERN-64-6(p.1-30))
interactions with mesons (π^-) at 6.8 and 7.5 Bev/c, meson (π^0) production in, 18: 20902 (JINR-E-1557)
interactions with mesons (π^-), singularity in, 18: 20903 (JINR-E-1581)
interactions with neutrons and protons at 23.1 Mev, phase shift analysis of, 18: 20904 (JINR-P-1553)
interactions with mesons ($\pi^\pm$) to 700 Mev, phenomenological analysis of, 18: 20915 (TID-20190)
interactions with mesons (π^-), 726-Mev resonance (K-π) in, 18: 20918 (UCRL-10797)
interactions with protons, peripheral production of F_{35} isobar (1922 Mev) in, 18: 20927
meson (μ) capture by, in 2s-1d nuclei, 18: 21277
range-energy relation in nuclear emulsion at 0.3 to 1.2 Mev, 18: 20372
reaction with metals at 260 kev, uv radiation emission in, 18: 20781
reactions (p,α) with aluminum-27 at 9 to 12 Mev, cross-section fluctuations in, 18: 21237
reactions (p,γ) with potassium-39 at 6 to 15 Mev, differential cross sections and yields for, 18: 21363
reactions (p,γ) with nuclei, analysis of gamma spectra from, 18: 21202 (KR-64(Sect.XXXII))
reactions (p,γ) with carbon-13, nitrogen-14 decay from, 18: 21261
reactions (p,d) with $23 \leq Z \leq 28$ nuclei at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
reactions (p,d) with nuclei at 28 Mev, angular distribution dependence on final state spin in, 18: 21299
reactions (p,n) with aluminum, heavy water, lead, and uranium at 6 Bev, 18: 21698(R) (ANL-6860)
reactions (p,n) with tritium, 18: 21217
reactions (p,n) with nuclei, threshold energies and curve shapes for, 18: 21284
reactions (p,n) with nitrogen-14, yields in, 18: 21336
reactions with bromine and silver, angular correlation of fragments in spallation, 18: 21229
reactions with nuclei at 660 Mev, spallation fragments in, 18: 21230
scattering by aluminum, K-shell x-ray emission in, 18: 20734(T) (UCRL-Trans-1050(L))
scattering by beryllium-9 at 5 to 15 Mev, differential cross sections for, 18: 21365
scattering by calcium-40, cross sections for elastic, 18: 21338
scattering by carbon-12, polarization in elastic, 18: 21300
scattering by carbon-12 at 8.5 Mev, inelastic, 18: 21254
scattering by copper-63 and -65 at 7.54 to 14.64 Mev, 18: 21171 (INSJ-68)
scattering by copper, iron-54, and nickel at 7 to 12 Mev, angular distributions from elastic (E), 18: 21292
scattering by nuclei at small angles, multiple effects in, 18: 21242
scattering by nuclei at high energies, energy losses in, 18: 21302
scattering of, spin flip and substate excitation in inelastic, 18: 21252

PSEUDOUREA, 2-(2-AMINOETHYL)-2-THIO-
effects on DNA synthesis in mice, 18: 19524
protective effects against x radiation in mice, mechanism for, 18: 19772
protective effects against x irradiation in dogs, 18: 19794
protective effects against x irradiation in dogs, 18: 19795
protective effects against x irradiation in mice, 18: 19796
protective effects against radiation injuries in mice, effects of solvent on, 18: 19797
protective effects in rats against radiotherapy for Walker carcinomas, 18: 19798
radiation effects on mouse metabolism of 2-mercaptoethyl-, 18: 19772
radioprotective effects of, mechanism for, 18: 19771
sulfur-35 uptake by, incorporation in tumor-bearing mice, 18: 19774

PULSE ANALYZERS
data handling for, 18: 20375
design of pulse pile-up rejector using tunnel diodes, 18: 20296
design of transistorized single-channel, 18: 20302
design of voltage-dividing, operating on ratios, 18: 20358
output dependence of tunnel diode amplitude discriminators on threshold excess, 18: 20291

PULSE GENERATORS (ELECTRONICS)
design of nsec-range, 18: 20300
design of quick-recovery, for 2 to 10 μsec and 0 to 10 volts, 18: 20284 (NAA-SR-Memo-8435)
design of square-wave, for use up to 250 Mc, 18: 20303
operation for production of accelerated charged-particle beams, duty factor for, 18: 20684

PULSE MODIFIERS
design and performance of linear parallel-to-serial converters, 18: 20290
development of pulse formers with predetermined limits of frequency and time, 18: 20317

PULSES
recording on magnetic tape, two modes for, 18: 20276 (AAEC/TM-227)

PUMPS
seals for, development of high-pressure, 18: 20133(R) (NYO-9802)

PUMPS (LIQUID METAL)
development of permanent-magnet-rotor, 18: 20131 (NAA-SR-Memo-2368(Rev.))

PYRENE
spectra of solutions of, beta and uv excitation, 18: 20046

PYRIDOXAL
leucine-pyridoxal, deuterium exchange in, 18: 20027

PYRITES
lead isotopic ratios in Sudbury, Ontario, gas source mass spectrometry of, 18: 20203

PYROCATECHOL, 4-(2-AMINOETHYL)-
preparation by photochemical reduction of dioxyphenylalanine, 18: 20081

PYROGALLOL
use in determination of antimony, 18: 19855(T) (UCRL-Trans-1011(L))

PYRROLIDONE, VINYL- POLYMERS
radiation effects on, protective effects of thiourea against, gamma, 18: 20056
radioprotective effects of mouse bone marrow and spleen cells preserved with, 18: 19778

Q

QUALITY CONTROL
performance evaluation system for machining personnel, 18: 21731 (Y-1461)
vendor attitude toward quality survey, 18: 21718 (SC-R-64-135)
QUANTUM ELECTRODYNAMICS
electron-nucleon processes in, 18: 21014
QUANTUM MECHANICS
amplitudes for potential scattering in, at large angular momenta, 18: 21036
analytic self-consistent field functions for configurations $1s^2 2s 2p_0$, 18: 20759
analytical properties of the Green function and mass operator, 18: 20987
angular momentum in, Clebsch-Gordon coefficients for, 18: 20991
book: *Hilbert Space with Nuclear Functions*, in German, 18: 21341
book: *Quantum Field Theory and the Many-Body Problem*, 18: 21067
bose gas, nonlocal field operators in system of hard-sphere, 18: 21028
calculations of differential cross sections in small-angle molecular beam scattering, 18: 20736
cluster expansion in the Heitler-London approach to many-electron problems, 18: 20747
correlation functions of classical gases, cluster property of, 18: 21059
Coulomb Green's functions and Furry approximation in, 18: 21027
dissipation in, 2-level systems for, 18: 21046
eigenstates of pairing-force Hamiltonian for many-boson system with N-body interaction in, 18: 21034
eigenvalue of ground-state three-body system in, upper and lower bounds of, 18: 21048
field theory in, axioms for multilocal, 18: 21056
field theory in, analytical representation of invariant distributions of, 18: 21068
field theory in, functional integration techniques in, 18: 21065
formulation of dynamic laws in the quantum theory of fields, 18: 21023 (NP-13878)
intensive observables in, 18: 21026
interaction potentials of, exactly soluble 1-dimensional N-body, 18: 20923
Lorentz invariance and interaction symmetries, 18: 21052
measurements in, time-correlation, 18: 21051
modification of available momentum region in Thomas-Fermi theory, 18: 20778
perturbation theory of molecular hydrogen, 18: 20743
phase-space formulation of canonical-variable dynamics, 18: 21031
Poisson brackets, 18: 21058
quantum cell model for hard spheres, 18: 21053
radial quantum hydrogenic integrals, 18: 21061
scattering amplitudes in, Watson-Sommerfeld transformation for many-particle, 18: 21040
scattering by potentials with an inverse-square attraction, 18: 21055
statistical mechanics of moderately dense fluids in, theory of irreversible, 18: 20633 (TID-20512)
theory of a generalized Yang-Mills field, 18: 21069
transport properties of quantum systems, 18: 21070
wave equations in, norm invariance of mass-zero, 18: 21032
QUARTZ
contamination of semiconductors grown in, use of radioisotopes for detection of, 18: 20420
radioinduced defects in germanium-activated crystals of, 18: 20587
radioinduced reactions with glycine, nitrate formation in, 18: 20045
reflectance of crystalline, 18: 19837(R) (MIT-905-1)

R

RABBITS
oxygen balance in bone marrow and brain of, effects of radioprotective compounds on, 18: 19801
ozone effects on x-irradiated erythrocytes in, 18: 19538
radiation effects on lipids of, x, 18: 19561
radiation effects on palmitic acid metabolism in, x, 18: 19665
radiation effects on regenerative processes related to blood letting in, gamma, 18: 19611(T)
radiation effects on anesthetized, x, 18: 19612(T)
radiation effects on cartilages of growing larynx in, 18: 19700
radiation effects on antibody production in, x, 18: 19722
radiation effects on visual analyzers in, x, 18: 19728
radiation effects on blood loss in, 18: 19732
radiation effects on antibody formation in, 18: 19735
radiation effects on leukocyte phagocytosis in, x, 18: 19736
radiation effects on immune reactions to smallpox in, x, 18: 19737
radiation effects on testes and reproductive capacity of, gamma, 18: 19755
radiation effects on agglutinins in, restoration effects of immune donor nucleoproteins on, x, 18: 19765
radiation effects on *Bacterium paratyphosum* agglutinin production in, x, 18: 19738
radiation used with cortisone in, effects on skin homografts, 18: 19613(T)
radioinduced chorioretinal burns of eyes of, 18: 19547(R) (AMRL-TDR-63-71)
radioinduced leukocytosis in, gamma, 18: 19697
RADIATION
absolute measurement of border ray r-unit, 18: 19825
analysis in plants, method for, 18: 19856
biological effects on activity of lactic acid dehydrogenase and elements of peripheral blood in mice, 18: 19705
carcinogenic effects of, reaction mechanisms for, 18: 19505 (BNL-7912)
carcinogenic effects, 18: 19595
dose distributions from pendulum and rotational irradiation, use of computer in calculating, 18: 19831
dose fractionation, protective effects on human kidney cells, 18: 19760
doses received in land target recovery processes, 18: 20237 (USNRDL-TR-700)
dosimetry of mixed fields of, in reactors, design of calorimeter sondes for, 18: 20379
dosimetry of, in biological studies, 18: 19549 (NP-13857)
dosimetry of, recommendations of International Commission on Radiological Units and Measurements, 18: 19815 (NP-13856)
effects and uses in agriculture, bibliography on, 18: 20423
effects of background, on Streptomyces, 18: 19560
effects on amoeba, restoration of lethal, 18: 19637
effects on antibody formation in combined administration of various antigens, 18: 19735
effects on bone marrow stem cell kinetics in fasted mice, 18: 19636
effects on cells and macromolecules, heavy-ion, 18: 19571
effects on content and metabolism of 5-hydroxytryptamine in rats, 18: 19652
effects on deoxyribopolynucleotide content in hematopoietic and lymphatic tissues in mice, 18: 19630
effects on desoxycytidine excretion by rats, 18: 19684
effects on diploid and polyploid yeast cells, 18: 19678
effects on DNA conposition in small intestines and spleen in rats, 18: 19682
effects on dog and man of whole-body, protective effects of bone marrow transplants against, 18: 19764
effects on dogs, 18: 19603
effects on *E. coli*, effects of medium on, 18: 19681
effects on human hematological response of, homogeneous *vs.* inhomogeneous, 18: 19584
effects on human male sterility after accidental exposure, 18: 19648
effects on lipid metabolism in human blood and bone marrow cells, 18: 19552(R) (NYO-2769-1)
effects on mammalian tumor cells, 18: 19572
effects on mice, protective effects of fresh vs. stored bone marrow against, 18: 19777
effects on mice, protective effects of radiation-resistant whole bacterial cells against, 18: 19808
effects on mitotic cycle in cornea and intestinal epithelia, 18: 19689
effects on mouse peritoneal cell transplants, 18: 19591
effects on oxygen consumption by rats, effects of adrenaline and atropine on, 18: 19742
effects on pepsin, effects of oxygen on, 18: 19692
effects on rat thymic lymph cells, 18: 19674

effects on static electric charge, 18: 20068
effects on stem cells in mice, effects of erythropoietin on, 18: 19635
effects on Tradescantia genetics, model for relation of, to LET, 18: 19573
effects on tumor incidence in residents of Hiroshima and Nagasaki, 18: 19596
effects on virus disease immunity, review, 18: 19747
for diagnosis, gonadal doses from, 18: 20264
hazards from medical and industrial exposure, 18: 20241
induction in homogeneous system in multimode resonator, theory of stationary, 18: 20310
induction of chromosomal aberrations by, mechanisms for, 18: 19559
leukemia induced by, resistance of black mice to, 18: 19663
leukemogenesis in man, 18: 19579
leukemogenic effects of background, in New England, 18: 20214
medical use of ionizing, code of practice for, 18: 20244
monitoring at Julich Nuclear Research Center, equipment for, 18: 20257
quality and biological effect, 18: 19570
reactions in phosphorus, luminescence relaxation in, 18: 20078
regulations for use of, 18: 20249
resistance in *E. coli*, gene locus for, 18: 19619
units and quantities of, 18: 19549 (NP-13857)
use in universities, code of practice for, 18: 20245
uses in preservation of food, survey of, 18: 19658

RADIATION CHEMISTRY
developments at Boris Kidric Nuclear Science Institute, Yugoslavia, 18: 20082
induction of graft polymers of cotton with polyacrylonitrile and polystyrene, thermal stress properties of products in, 18: 20084
of aqueous solutions, calorimeters for study of, 18: 20083
of Diels-Alder Reaction, 18: 20088
of oxygen and oxygen mixtures with nitrogen and rare gases, formation of ozone in, 18: 20095
of phenyl alkyl ketones, use of mass spectra in, 18: 20063
of polyisobutene, effects of additives on, 18: 20066
of polyisobutene, effects on infrared and ultraviolet spectra of, 18: 20065
of water in acid, basic, and neutral solutions, review of free radicals yields in, 18: 20037 (BNL-6978)
research progress in, 18: 20044
review, 18: 20044

RADIATION DAMAGE
calcite dating by uranium-fission, 18: 20224
in electronics of nuclear space vehicles, 18: 20304

RADIATION DETECTION INSTRUMENTS
design and construction for measurement of boundary between inactive and radioactive solutions, 18: 20010
design for reactor-area monitoring, 18: 21562 (CEA-R-2401)
design for spacecraft, 18: 20412
design for studying interactions at cosmic energies, 18: 20325(R) (AROD-2427:1)
development for detection of alpha particles from uranium-238 (n,α)-thorium-235 reactions, 18: 20403
scanning system using, design of whole-body, 18: 19818
use of jacketed, for plant assay and autoradiography, 18: 19856

RADIATION DETECTION INSTRUMENTS (ION CURRENT TYPE)
development of neutron, for high-temperature operation, 18: 21564(R) (GEMP-81)

RADIATION DETECTION INSTRUMENTS (PULSE TYPE)
calibration of, for whole-body counting, 18: 20340(R) (TID-20525)
collimators for use with, in radioisotope-scanning systems, 18: 20416
data analysis for scanning systems using, 18: 19835
description of scintillator-photomultiplier system for electron diffraction studies on thin foils, 18: 20670
design and performance using liquid scintillators, 18: 20335 (NP-13840)
design for satellite cosmic-ray measurements, 18: 20828
design of two-crystal, for whole-body counting of gamma radiation, 18: 20337 (NYO-2553-1)
development for low-energy environmental monitoring, 18: 20341 (TID-20564)
development of, review of, 18: 20406
operation of Geiger-Mueller, effects of radial thermal gradient on, 18: 20404
performance characteristics of carbon dioxide-filled, 18: 20397
stability of end-window Geiger-Mueller, 18: 20381

RADIATION DETECTORS
book: *Radiation Protection Practice. Part II. Measurement Techniques*, in German, 18: 20275
performance of simulated, use of statistical estimation theory to evaluate, 18: 20415
radioinduced electric currents in teflon scatters in, 18: 20592
use of chromosomal aberrations as biological, 18: 19643

RADIATION EFFECTS
book: *Effect of Radiation on Metals and Other High-Melting Materials*, 18: 20601
on components and circuits, transient, 18: 20321
on engineering materials in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
on mechanical properties of refractory metals, review, 18: 20456 (ORNL-3593)
on plastics and rubbers, guide to, 18: 20582 (NIRL/R/58)

RADIATION INJURIES
acute syndrome of, 18: 19588
book: *Radiation Protection Practice. Part I. Fundamentals*, in German, 18: 20274
chemical prophylaxis of, review of agents and mechanisms for, 18: 19791
modification of, conference on physical factors affecting, 18: 19569
of the lung, 18: 19694
prevention and treatment of, 18: 20241
protection against, using nitroamidines in rats, 18: 19782
recovery from, hypothesis for, 18: 19575
recovery from, in mammals, 18: 19762
repair in frogs, 18: 19781(T)
repair of, in normal and neoplastic tissues, 18: 19802
therapeutic measures for human, 18: 19763
to right hand of laboratory worker handling x-ray tubes, 18: 19706
treatment in thermonuclear warfare, 18: 20258

RADIATION MONITORING
equipment and procedures for reactor-area, 18: 21562 (CEA-R-2401)

RADIATION PROTECTION
book: *Radiation Protection Practice. Part I. Fundamentals*, in German, 18: 20274
book: *Radiation Protection Practice. Part II. Measurement Techniques*, in German, 18: 20275
during operation of large radiation sources in Poland, 18: 20260
effects of fresh vs. stored bone marrow in mice, 18: 19777
effects of PVP-preserved bone marrow and spleen cells, 18: 19778
for radiological recovery of land target components, 18: 20237 (USNRDL-TR-700)
in industrial flaw detection laboratories in Poland, 18: 20259
measures for medical use of isotopes, 18: 20254
measures for uranium milling, USAEC, 18: 20272
methods for skin in radiotherapy using barium, bismuth, lead, and zinc pastes, 18: 19832
program of Food and Drug Admin., 18: 20255
regulations for, Great Britain, 18: 20242

RADIATION-SCATTERING ANALYSIS
method and apparatus for, 18: 20322(P)

RADIATION SICKNESS
enzyme reactions during, in dogs, 18: 19683
protection against, using bone marrow transplantation, effects of anemic blood plasma on, 18: 19804
protective effects of serotonin against hemorrhage in, 18: 19696
therapy, 18: 19793
tuberculosis resistance in, in guinea pigs, 18: 19715

RADIATION SOURCES
book: *Radiation Protection Practice. Part II. Measurement Techniques*, in German, 18: 20275
design of 24-curie, for whole-body irradiation, 18: 19819
radiation protection during operation of, in Poland, 18: 20260
safety in industrial use of, 18: 20253
use of sealed, regulations for, 18: 20242
use of sealed, regulations for, 18: 20243

RADIATION TARGET CANS

bonding in, inductive thermometric measurement of, 18: 20282 (HW-SA-3035)
RADIATION TARGETS
design for bombardment by neutron beams, 18: 21130 (KR-64 (Sect.XXX))
design of scattering chamber for cyclotrons, 18: 20688
fabrication of bismuth, for polonium-208 production in Mark I accelerator, 18: 20486 (MTA-15)
radiation effects on interior, in circular accelerators, 18: 20687
RADICALS
formation of aliphatic, 18: 19837(R) (MIT-905-1)
RADIOACTIVE CONTAMINATION
book: *Radiation Protection Practice. Part II. Measurement Techniques*, in German, 18: 20275
of municipal water facilities by nuclear attacks, 18: 20233 (NP-13806)
RADIOACTIVE MATERIALS
accidents involving, radiological emergency procedures for laymen involved in, 18: 20273
content in atmosphere from fossil-fueled power plants, 18: 20265
hazards from industrial exposure of man to, 18: 19597
transport of, regulations for, 18: 20248
RADIOACTIVE MINERALS
rare earth ratios in, 18: 20227
RADIOACTIVITY
British act of 1960 on, 18: 20246
determination in food and total diet by FDA, program for, 18: 20255
in Columbia River sediment, 18: 20219
levels in vertebrates, 18: 19517
monitoring in photographic industry, 18: 20251
of building materials, gamma, 18: 20210 (CLOR-20)
of rain water in Illinois, relations with rainfall factors, 18: 20617 (COO-1199-3)
production by nuclear explosions, 18: 20124 (UCRL-7761)
RADIOAPPLICATORS
for radium therapy of uterine cancer, 18: 19830
RADIOBIOLOGY
bibliography on dosimetry for, 18: 19549 (NP-13857)
book: *Radiation Protection Practice. Part I. Fundamentals*, in German, 18: 20274
handbook on dosimetry, 18: 19549 (NP-13857)
low-dose-exposure effects on human populations, review of recent research on, 18: 19625
RADIOCHEMISTRY
research progress on, 18: 21712(R) (NYO-10065)
solvent extraction in, review of, 18: 20085
RADIODERMATITIS
effects on human lymph vessels in, 18: 19604
RADIODIAGNOSIS
data recording system evaluation for, 18: 19835
effects on human populations, review of low-dose, 18: 19625
gonadal doses from, 18: 20264
iodine-131 and iodine-132 for, dosage and uptake measurements of, 18: 19822
of eye tumors, 18: 19823
of liver diseases by scanning after the administration of molybdenum-99, 18: 19834
of occlusive cerebral vascular disease using arsenic-74 and copper-64, 18: 19817
of spinal cord using Thorotrast, injuries to nervous system from, 18: 19659
radiation dose distribution in, use of computer in calculating, 18: 19831
use in dentistry, exposure from, 18: 20261
use of labeled colloidal albumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
use of technetium-99m for organ scanning, 18: 19814 (CONF-453-1)
RADIOFREQUENCY SPECTROMETERS
noise suppression in, 18: 19995
review, 18: 19994
RADIOGRAPHY
exposure control in, device for, 18: 19829
radiation protection in industrial flaw detection laboratories in Poland, 18: 20259
use in highway construction, 18: 20120
use of ytterbium-169 in aluminum and steel, 18: 20425
RADIOISOTOPES
determination in element or binary compound, calculation method for, 18: 20069
determination in mixtures by beta radiation, 18: 19911
half lives of short-lived isomeric states of, 18: 21249
medical use of, exposure and protection from, 18: 20254
preparation of carrier-free, theory of, 18: 20071
preparation of short-lived, for tracer studies in petroleum hydrocarbons, 18: 20427(P)
production and uses, 18: 21706(R) (KR-66)
use as energy sources, 18: 20428
use for detection of surface contamination on semiconductors, 18: 20420
use in analytical methods, review of, 18: 19867
use in industry, 18: 20425
use in textile industry, 18: 20424
uses in agriculture, bibliography on, 18: 20423
uses of, data and principles for insurance premium calculations for, 18: 20250
RADIOLOGICAL TELEMETERING SYSTEMS
design and performance, 18: 20225
RADIOLOGICAL WARFARE
contamination of municipal water facilities by nuclear attacks, 18: 20233 (NP-13806)
design of dual-use military shelters for, 18: 20197 (NAVDOCKS-P-310)
food crop contamination by fallout during, 18: 19515 (NP-13796)
medical care of casualties in, 18: 19793
RADIOLOGY
dosimetry in, recommendations of International Commission on Radiological Units and Measurements, 18: 19815 (NP-13856)
RADIOMETRIC ANALYSIS
developments in, review of, 18: 19867
method of beta, 18: 19911
methods for mixed beta-source, 18: 19872
methods for mixed beta-source, 18: 19873
RADIOMIMETIC SUBSTANCES
resistance in *E. coli*, gene locus for, 18: 19619
RADIOPROTECTIVE COMPOUNDS
effect, on tumor-bearing mice, 18: 19774
effects on oxygen balance in bone marrow and brain, 18: 19801
mechanism of, 18: 19771
mechanism of cystamine, 18: 19800
properties of diethylstilbertrol, 18: 19799
properties of substituted aromatic amidines as, 18: 19782
protein bonding of bis(2-guanidoethyl) disulfide, 18: 19773
review of agents and mechanisms, 18: 19791
role of rutin and ATP as, for protection of lungs, 18: 19807
use of cysteamine as, in mice after fractionated irradiation, 18: 19775
use of propylthiouracil as, 18: 19780
use of serotonine as, against radioinduced sterility in mice, 18: 19711
use of 2-(2-aminoethyl)-2-thiopseudourea and *p*-aminopropiophenone as, 18: 19794
use of 2-(2-aminoethyl)-2-thiopzeudourea and *p*-aminopropiophenone as, 18: 19795
use of 2-(2-aminoethyl)-2-thiopseudourea as, 18: 19796
RADIOSENSITIVITY
effects of LD_{50} on, 18: 19575
index of, in mice, 18: 19680
of bone marrow cells in rats, 18: 19660
of *Drosophila melanogaster*, effects of postirradiation cold treatment on, 18: 19707
of maize hybrids, 18: 19746
of snails, effects of age on, 18: 19698
of tumors, 18: 19606
oxygen effect in, 18: 19692
radiation effects on, gamma, 18: 19686
sites in Tribolium embryos, use of linear accelerators for finding, 18: 19668
RADIOSTERILIZATION
of Anopheles, gamma, 18: 19654

of beef, effects on texture, 18: 19758
of pork meat, heat treatment effects on, 18: 19617
of pork meat, heat treatment effects on, 18: 19616
RADIOTHERAPY
bone fracture incidence after supervoltage, 18: 19693
collimator for 14-Mev neutron, development of steel, 18: 19821
dosage determinations for, 18: 19828
dosimetry in, recommendations of International Commission on Radiological Units and Measurements, 18: 19815 (NP-13856)
effects on human populations, review of low-dose, 18: 19625
for cervical carcinomas, febrile reactions during gamma, 18: 19792
kidney protection in, 18: 19703
liver function disturbances in, 18: 19720
of blood cells by telecobalt, blood count changes after, 18: 19749
of breast carcinomas, effects of, on bones, gamma and x, 18: 19673
of carcinoma of urinary bladder, 18: 19827
of carcinomas of skin or lips, development of radioinduced ulcers in, 18: 19714
of cervical carcinomas followed by pregnancy, radium and x, 18: 19565
of lymphosarcomas, pneumonitis induction by, x, 18: 19566
of mycosis fungoides using electrons from linear accelerators, 18: 19820
of pituitary gland, using yttrium-90 seeds, 18: 19824
of polycythemia using phosphorus-32, effects on blood volume, 18: 19661
of rat carcinomas, protective effects of chemicals in, 18: 19798
of tumors, model for neutron, 18: 19816
of uterine cancer, devices for, 18: 19830
of Walker carcinomas, cell nuclear diameter changes in, 18: 19699
osteonecrosis of femur in, 18: 19713
r-unit absolute measurement in, x, 18: 19826
radiation dose distribution in, use of computer in calculating, 18: 19831
radiation effects on skin in tele-gamma, 18: 19716
radiation protection by using barium, bismuth, lead, and zinc pastes for skin, 18: 19832
thyroid tumor incidence after, during childhood, 18: 19598
RADIOTOXICITY
of substances from x-irradiated cells and whole blood, 18: 19653
RADIUM
carcinogenic effects of, in man, 18: 19597
deposition in tissues of goldfish, 18: 19756
effects of exposure to, on life span of man, 18: 19551 (NYO-2762)
effects on goldfish blood, organs, and bones, 18: 19756
therapy of cervical carcinoma using, followed by pregnancy, 18: 19565
therapy of uterine cancer using, devices for, 18: 19830
RADIUM ISOTOPES Ra-223
half life, 18: 21709(R) (MLM-1179)
separation from uranium ore, radiochemical, 18: 19840 (CEA-R-2419)
RADIUM ISOTOPES Ra-226
content in atmosphere from fossil-fuel power plants, 18: 20265
content in human bones and teeth, 18: 19532
determination of, radiochemical, 18: 19840 (CEA-R-2419)
pathological effects of, in man, 18: 19550 (NYO-2181-1)
RADIUM ISOTOPES Ra-228
content in atmosphere from fossil-fuel power plants, 18: 20265
determination in man by whole-body counting after Thorotrast injection, 18: 20340(R) (TID-20525)
pathological effects of, in man, 18: 19550 (NYO-2181-1)
RADON
determination in atmosphere, instrumentation for, 18: 20341 (TID-20564)
mine ventilation for control of, 18: 20269
sorption by activated charcoal and silica gel, 18: 19940(T) (SC-T-64-613)
RADON ISOTOPES Rn-220
content in mines, measurement of, 18: 20268
determination in air, development of direct method for, 18: 19893
RADON ISOTOPES Rn-222
content in mines, measurement of, 18: 20268
RAIN WATER
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
radioactive rainout relations in sampling networks in Illinois, 18: 20617 (COO-1199-3)
strontium-90 content in, variations of, 18: 20215
RARE EARTH ISOTOPES
energy levels of, calculation using pairing correlations, 18: 21179 (JINR-P-1573)
RARE EARTH MINERALS
analysis of, gravimetric, 18: 19909
rare earth ratios in, 18: 20227
RARE EARTH NITRATES
analysis of, coulometric and polarographic, 18: 19851(R) (TID-20548)
RARE EARTH PERCHLORATES
analysis of, coulometric and polarographic, 18: 19851(R) (TID-20548)
RARE EARTHS
analysis of, coulometric and polarographic, 18: 19851(R) (TID-20548)
content in minerals, ratios of, 18: 20227
content in stellar red giants, mechanisms for, 18: 20727
determination in alloys and minerals, gravimetric, 18: 19909
determination in zirconium–rare earth alloys, gravimetric, 18: 19839 (BM-RI-6430)
electrodeposition of films of, by molecular plating, 18: 20495
separation by solvent extraction using TBP, calculation of cascade stagewise conditions for, 18: 20098 (IS-780)
separation from scandium by ion exchange in chloride–thiocyanate media, 18: 20113
separation from uranium by ion exchange in aqueous malonic acid, 18: 20114
separation from zirconium by cation exchange, 18: 19839 (BM-RI-6430)
solubility polytherms for systems of nitrates of ceric, 18: 20108
RARE GASES
chemistry of, 18: 19997
diffusion of radiogenic and spallogenic, from stony meteorites, 18: 20206
lithium-7 scattering by, theory of, 18: 20763
sputtering reactions of ionic, 18: 20745
RATS
bioelectrogenic mechanisms in stomachs of, ionic relation of, 18: 19521 (USNRDL-TR-716)
bismuth uptake and distribution in, 18: 19529
bone marrow cell counts in, quantitative, 18: 19510
cesium-137 uptake by, effects of ferric cyanoferrate(II) on, 18: 19534
hypertension induction in, effects of excess salt ingestion and genetic factors on, 18: 21702 (BNL-7971)
ozone effects on x-irradiated erythrocytes in, 18: 19538
polonium-210 distribution in hypophysis, parathyroid, and thyroid glands, 18: 19542
radiation effects on bone growth in, 18: 19555 (USNRDL-TR-721)
radiation effects on lymph node plasmacytic reaction in, x, 18: 19557(T) (JPRS-23956(p.18-26))
radiation effects on ears of, gamma and x, 18: 19562
radiation effects on serum proteins in, temperature effects on, gamma, 18: 19642
radiation effects on 5-hydroxytryptamine content and metabolism in, 18: 19652
radiation effects on strontium-90 uptake by teeth of, x, 18: 19655
radiation effects on saccharin response in, x, 18: 19667
radiation effects on liver cell lysosomes of, from plutonium-239, 18: 19669
radiation effects on thymic lymph cells in, 18: 19674
radiation effects on suprarenals in, x, 18: 19676
radiation effects on life span and hematopoietic system in, 18: 19677
radiation effects on DNA composition in small intestines and spleen in, 18: 19682
radiation effects on desoxycytidine excretion by, 18: 19684
radiation effects on urinary excretion of 5-hydroxyindoleacetic acid in, 18: 19626
radiation effects on hippuric acid synthesis in liver of, effects of glycine on, 18: 19631
radiation effects on bilirubin conjugation and excretion in liver of, 18: 19632
radiation effects on urinary excretion of 5-hydroxyindoleacetic acid in, effects of cystamine on, 18: 19639
radiation effects on responses of, x, 18: 19586
radiation effects of abdominal exposure in, x, 18: 19587
radiation effects on blood serum metabolism in, x, 18: 19590
radiation effects on vaccinia viruses in, effects of injection on, uv, 18: 19614

radiation effects on phosphonucleoside contents of organs of, 18: 19702
radiation effects from combined external and internal irradiation on lactic acid dehydrogenase activity in, 18: 19705
radiation effects on extracellular space of organs and inulin permeability of gastrointestinal tract, 18: 19718
radiation effects on antibody production in, x, 18: 19722
radiation effects on neural system of, x, 18: 19729
radiation effects on oxygen consumption by, effects of adrenaline and atropine on, 18: 19742
radiation effects on proteolysis in kidneys and skeletal muscles of, gamma, 18: 19745
radiation effects on serum proteins of, x, 18: 19754
radiation effects on, protective effects of bone marrow against, gamma, 18: 19769
radiation effects on, chemical protection against, x, 18: 19779
radiation effects on, protective effects of propylthiouracil against x, 18: 19780
radiation effects on hair of, protective effects of cystamine and cysteamine against, x, 18: 19784
radiation effects on iron-59 uptake by mucosa of, protective effects of MEA against, x, 18: 19787
radiation effects on submucosal tissues of, protective effects of Tanderil (oxyphenylbutazone) against, gamma, 18: 19803
radiation effects on oxygen consumption by, effects of insulin on x, 18: 19806
radiation effects on ATP- and rutin-treated lung tissue of, gamma, 18: 19807
radiation effects on testes of, 18: 19709
radiation sickness of, effects of anemic blood plasma on effects of bone marrow transplantation on, 18: 19804
radioactivity of, effects of environment on, 18: 19517
radioinduced erythopoiesis in, gamma, 18: 19593
radioinduced liver degeneration in, effects of irradiated bone marrow on x, 18: 19790
radiosensitivity of bone marrow cells in, 18: 19660
radiotherapy of carcinomas in, protective effects of chemicals in, 18: 19798
radiotoxins in, 18: 19653
uptake of labeled amino acid by isolated intact diaphragm of, effects of insulin on, 18: 19540

REACTION MECHANISMS
of radioinduced Diels-Alder adduct formation, 18: 20088
probability curves for recoil-atom, neutron cooling-down model of, 18: 20041 (MMPP-167-6)
use in chemical analysis, review of, 18: 19868
use of mass spectrometers for studying appearance potentials and ion-molecule reactions, 18: 21703 (CONF-296-4)

REACTOR CONTROL RODS
conference on physics and material problems of, IAEA, Vienna, Nov. 11 to 15, 1963, summary, 18: 21574
neutron absorption by, DIRAC optical distribution function for, 18: 21151

REACTOR CONTROL SYSTEMS
analysis of ANP open-cycle fast reactor, 18: 21561 (APEX-603(Del.))
chemical shim, for power reactors, 18: 21652
design for gas-cooled reactors, 18: 21579
design for 630A Maritime Nuclear Steam Generator, 18: 21668(R) (GEMP-274)
design of fail-safe circuits for safety systems, 18: 21580
development, 18: 21564(R) (GEMP-81)
development for South African Safari I, 18: 21686
development of circulating loop using boric acid solution, 18: 21565 (IDO-16812)
optimization of startup, 18: 21559
shutdown device for gas-cooled reactors using neutron-absorbent gas, 18: 21588(P)
use of electrolyte addition to control power level in homogeneous reactor, 18: 21582(P)

REACTOR COOLANTS
evaluation of aromatic petroleum fractions as organic, 18: 19836 (EUR-496.f)
flow distribution in SNAP-2, effects of "unfed" peripheral coolant channels on, 18: 21673 (NAA-SR-Memo-9576)
heat transfer in liquid sodium, burnout problems in, 18: 20193
performance of liquid sodium as, reliability of, 18: 20194
processing of organic, by vacuum flash distillation, 18: 21552 (NAA-SR-Memo-7545)
processing of organic, saturation determination of adsorbant for, 18: 21553 (NAA-SR-Memo-7771)
properties of liquid-metal, evaluation of, 18: 20192
radiolysis in boiling water reactors, hermetic sealing and recombiner problems from, 18: 21672 (NAA-SR-Memo-9507)
separation of fission products from gaseous, process plant for, 18: 21584(P)

REACTOR COOLING SYSTEMS
design for pool reactors, 18: 21688
performance of, using two-phase flow, 18: 20182 (TID-7694(p.108-49))

REACTOR ENGINEERING
analysis of deformation of grid support structures, 18: 21581
application of optimum control to reactor startup, 18: 21559
developments in, 18: 21698(R) (ANL-6860)
Large Component Test Loop for studying effects of flowing sodium on reactor components, 18: 21570 (NAA-SR-Memo-8217)
prediction and control of leakage through cracks and capillaries in concrete housing structures, 18: 21555 (NAA-SR-Memo-9429)
statistical determination of extrapolation errors in cylindrical reactors 18: 21550 (EUR-1624.e)
tridimensional theory of heterogeneous reactors, 18: 21560

REACTOR EXPERIMENTAL FACILITIES
beam hole shutter plug development, 18: 20134(R) (ORNL-TM-792)
neutron beam extraction systems for, 18: 21566 (KR-64(Sect.XXIX))

REACTOR FUEL ELEMENTS
alignment in reactor channel, device for, 18: 21621(P)
coating of aluminum-clad, with nickel by chemical method, 18: 20453 (HW-72415)
design for reduced sheath stretching during thermal cycling, 18: 21627(P)
design for 630A Maritime Nuclear Steam Generator, 18: 21668(R) (GEMP-274)
design of bundle, for uniform surface thermal flow, 18: 21626(P)
design of cluster, with purge gas circuit for high-temperature gas-cooled reactors, 18: 21664(P)
design of finned, for improved heat transfer, 18: 21624(P)
design of finned, for improved heat transfer, 18: 21625(P)
development and testing for Advanced Sodium Cooled Reactor, 18: 21614 (NAA-SR-Memo-8017)
dissolution of, electrolytic, 18: 20115
handling of SGR, grapple-latch development for, 18: 21638 (NAA-SR-Memo-8266)
heat transfer burnout in rod bundle, effects of rod spacing on, 18: 21633(R) (DPST-64-83-1)
heat transfer by, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
heat transfer to liquid metals in cross-flow through rod-bundle, theory of, 18: 20185
radiation effects on, for fast reactors, 18: 21698(R) (ANL-6860)
radiation effects on, neutron radiography of, 18: 20591
reprocessing of spent, apparatus for removing rivets from casings, 18: 20159(P)
reprocessing of, fusible metal chucking for mechanical, 18: 20134(R) (ORNL-TM-792)
support in gas-cooled reactors, graphite jackets for, 18: 21618
thermocouple connections between cartridges in channel, device for, 18: 21622(P)
vapotron claddings for, 18: 21617 (TID-7694(p.71-84))
vibration analysis of large SGR, 18: 21615 (NAA-SR-Memo-9164)
welding by electron-beam methods, 18: 20491

REACTOR FUEL ELEMENTS (CERAMIC)
composition of iron–uranium nitride cermet, 18: 20465(P)
decladding of uranium dioxide, oxidative, 18: 20111
design of stainless steel-clad uranium dioxide pellet, for thermal expansion, 18: 21623(P)
development and fabrication of plutonium-based for, 18: 20460(T,R) (EURAEC-965)
fabrication and testing, 18: 20459(T,R) (EURAEC-954)
fabrication of plutonium bearing, electron-beam welding for, 18: 20492

neutron flux fine structure in clusters of uranium dioxide, 18: 21612 (CEA-2387)
production of plutonium carbide–uranium carbide, for fast reactors, 18: 20507(P)
production of plutonium carbide–uranium carbide, for fast reactors, 18: 20508(P)
properties of molten uranium dioxide, 18: 21620
radiation effects on coated-particle, 18: 21619
radiation effects on Magnox, 18: 20463
reactivity of plutonium oxide-uranium (IV) oxide, 18: 21613 (HW-79960)

REACTOR FUEL ELEMENTS (DISPERSION)
development for gas-cooled reactors, 18: 21659
development of graphite-matrix, 18: 20450(R) (BMI-1661(Del.))
fabrication of beryllium oxide-based, 18: 20497
fabrication of beryllium oxide-based, for optimum crystal structure, 18: 20498

REACTOR FUEL RODS
development and testing, 18: 21635(R) (GEAP-4481)

REACTOR FUEL SHEETS
testing of chromium–nickel clad, for 630A Maritime Nuclear Steam Generator, 18: 21668(R) (GEMP-274)

REACTOR FUEL SPHERES
development for pebble-bed reactors, 18: 21658

REACTOR FUELS
burnup in liquid-moderated reactors, 18: 21610 (AEEW-R-135)
coating of particulate, with pyrolytic graphite, 18: 20510(P)
development for fast reactors, 18: 21698(R) (ANL-6860)
development of coated-particle, 18: 20450(R) (BMI-1661(Del.))
development of coated-particle, 18: 20570
fission gas release from irradiated coated-particle, 18: 20450(R) (BMI-1661(Del.))
processing of beryllium oxide-containing, 18: 20116
processing of irradiated, by melt refining, 18: 21698(R) (ANL-6860)
processing of irradiated, 18: 21706(R) (KR-66)
radiation effects on coated-particle, 18: 20450(R) (BMI-1661(Del.))

REACTOR MATERIALS
development and properties, survey of, 18: 21558
properties of, technological review of, 18: 20558
purity measurement by oscillation method, device for, 18: 20281 (EUR-523.f)
welding of ferrous, by electroslag techniques, 18: 20488(T,R) (EURAEC-970)

REACTOR MATRICES
buckling in uranium carbide-sodium-graphite, 18: 21599 (NAA-SR-Memo-9382)
channel design with variable orifice for coolant temperature regulation, 18: 21568 (NAA-SR-Memo-8079)
criticality measurements on uranium-heavy water, pulsed-neutron, 18: 21595 (CEA-R-2376)
fast fission effect in heterogeneous, with coaxial cylindrical regions, 18: 21609
neutron thermal utilization factors of, computer program for, 18: 21597 (EUR-1606.e)
nuclear characteristics of circular and rectangular, comparison of, 18: 21604
parameters for uranium carbide-sodium-graphite, 18: 21600 (NAA-SR-Memo-9489)
physics calculations for organic-cooled uranium-heavy water, method for, 18: 21596 (EUR-597.e)
U–H_2O, review of physics measurements on, 18: 21594 (BNL-6975)

REACTOR MODERATORS
design of graphite, 18: 21577
neutron thermal diffusion length in, effects of empty channels on, 18: 21602

REACTOR SAFETY
containment in nuclear accidents, 18: 21641 (NP-13793)
fail-safe circuit for, 18: 21580
maximum credible accidents and requirements for containers for power reactors, 18: 21647
optimization of control during startup, 18: 21559
prediction and control of leakage through cracks and capillaries in reinforced concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)

REACTOR SAFETY EXPERIMENTS
pressure pulses in SPERT-I destructive transient, thermal mechanism of, 18: 21549 (CONF-187-111)

REACTOR SHIELDING
constants and cross sections for calculating, 18: 21545 (HW-73381 (Suppl.1))
design of lithium hydride-tungsten, for space vehicles, 18: 21676 (SSD-TDR-63-217)
gamma and neutron attenuation in thermal, calculation for power reactors, 18: 21636 (HW-72844)

REACTOR TUBES
design of pressure tube assembly with flow-limiting device in case of rupture, 18: 21585(P)
fabrication of hexagonal APM, for organic reactors, 18: 21569 (NAA-SR-Memo-8121)

REACTORS
analysis of, cross sections for, 18: 21551 (GEMP-283)
buckling in two-region system, 18: 21606
design of liquid moderator container, 18: 21589(P)
fuel burnup in liquid-moderated, 18: 21610 (AEEW-R-135)
heat transfer and two-phase fluid flow in, boiling, 18: 20171 (TID-7694(p.18-23))
height and radius of cylindrical, statistical determination of extrapolation errors in Monte Carlo calculation of, 18: 21550 (EUR-1624.e)
instrumentation for, development of, 18: 21564(R) (GEMP-81)
loading machine for, fluid coupling device for sealing to standpipe, 18: 21587(P)
neutron diffusion in, multigroup equations for, 18: 21155
neutron flux measurements in, feasibility of in-core ion chambers for, 18: 21563(R) (GEAP-4483)
neutron physics calculations for, use of multigroup transport theory in Monte Carlo, 18: 21601
neutron spectra in, calculation of thermal, 18: 21122 (EUR-1605.e)
radiation control around, system for, 18: 21562 (CEA-R-2401)
reactivity measurements on, pulsed neutron sources for, 18: 21605
shutdown time of, increasing time-to-poison, 18: 21687
structural supports for, analysis of deformation of, 18: 21581
supporting arrangement for core and pressure vessel, design, 18: 21590(P)

RECOIL IONS
reaction mechanism, 18: 20041 (MMPP-167-6)

RECTIFIERS
performance of silicon-controlled, peak-current, 18: 21741

REDUCING AGENTS
chemical effects on photochemical production of amines, 18: 20081

REFRACTORY COATINGS
deposition on graphite for oxidation resistance at high temperatures, 18: 20511(P)
properties on refractory metals, review, 18: 20452 (DMIC-195)

REFRACTORY MATERIALS
book: *Effect of Radiation on Metals and Other High-Melting Materials*, 18: 20601
properties of coated, review, 18: 20452 (DMIC-195)

REFRIGERANTS
thermodynamic properties, 18: 21095(R) (NBS-8239)

REFRIGERATION
development for cryogenic magnets, 18: 21095(R) (NBS-8239)

RELATIVITY THEORY
evolution of solar system and expansion of universe, 18: 20712
Lorentz invariance and interaction symmetries, 18: 21052
Mach's principle in general, 18: 21057
spherically symmetric space-times in general, 18: 20658
wave equations in, norm invariance of mass-zero, 18: 21032

REMOTE-CONTROL EQUIPMENT
design for removing rivets from casings of spent fuel elements, 18: 20159(P)
design for slitting fuel bundles, 18: 20134(R) (ORNL-TM-792)
design of storage apparatus for grabs for removing broken fuel element fragments from reactor channels, 18: 21583(P)
use of multiplex techniques in, for accelerators, 18: 20280 (CERN-64-21)

RENÉ-41

machining of, development of techniques for, 18: 20134(R) (ORNL-TM-792)
RESEARCH REACTORS
cooling system design for pool-type, 18: 21688
neutron beam extraction systems for, 18: 21566 (KR-64(Sect.XXIX))
nuclear characteristics of circular and rectangular core cells in, comparison of, 18: 21604
operation of NORA, Oct.-Dec. 1963, 18: 21706(R) (KR-66)
properties of Russian BR-5, 18: 21683(T) (ANL-Trans-9)
reactivity of Japanese UTR-B, effects of fuel element shift on, 18: 21684
use of AGN-201 Costanza, for measuring purity of reactor materials, 18: 20281 (EUR-523.f)
RESINS
molding into thin-wall spools used in fabricating superconducting magnets, method for, 18: 20134(R) (ORNL-TM-792)
sorptive properties for protactinium, 18: 20105
RESISTANCE THERMOMETERS
design of platinum, for 5-volt output at 1300°F, 18: 20283 (NAA-SR-Memo-8073)
RESORCINOL, 4-(2-PYRIDYLAZO)-
analytical use for spectrophotometric determination of rare earths, 18: 19895
RHAMNOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
RHENIUM
analysis for rhenium-186 and -188, calculation method for, 18: 20069
compatibility with uranium dioxide, 18: 20450(R) (BMI-1661(Del.))
corrosion by cesium at 750°C, 18: 20873
determination in rhenium–tungsten alloys, spectrographic, 18: 19881
development and properties as diffusion barrier for refractory metals, 18: 20445(R) (AD-434441)
diffusion in tungsten crystals, 18: 21335
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron reactions (n,γ) with, gamma spectra from, 18: 21205 (NP-13807)
performance compatibility with thermionic cell fission heat source, 18: 20874
performance compatibility with carbide fuel in thermionic cells, 18: 20878
RHENIUM ALLOYS
Re–Rh–Ti, superconductivity, 18: 21112
Re–W, analysis for rhenium, spectrographic, 18: 19881
RHENIUM COMPLEXES
with thiocyanate, valency in, 18: 20004
with thiocyanate, valency in, 18: 20006
RHENIUM ELECTRODES
Re–W, thermionic work function for, 18: 20867
RHENIUM ISOTOPES Re-186
energy levels of, rotational, 18: 21312
RHENIUM ISOTOPES Re-187
beta spectrum, 18: 20023 (TID-20510)
RHENIUM ISOTOPES Re-188
energy levels of, rotational, 18: 21312
RHODIUM
corrosion by cesium at 750°C, 18: 20873
determination of, optimum sample position in activation, 18: 19906
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359
stacking-fault energy, 18: 20550
RHODIUM ALLOYS
Au–Rh–Ti, superconductivity, 18: 21112
Co–Rh–Ti, superconductivity, 18: 21112
Cr–Rh–Ti, superconductivity, 18: 21112
Cu–Rh–Ti, superconductivity, 18: 21112
Fe–Rh–Ti, superconductivity, 18: 21112
Hf–Rh–Ti, superconductivity, 18: 21112
Ir–Rh–Ti, superconductivity, 18: 21112
Mn–Rh–Ti, superconductivity, 18: 21112
Mo–Rh–Ti, superconductivity, 18: 21112
Nb–Rh–Ti, superconductivity, 18: 21112
Ni–Rh–Ti, superconductivity, 18: 21112
Os–Rh–Ti, superconductivity, 18: 21112
Pd–Rh–Ti, superconductivity, 18: 21112
Pt–Rh, corrosion by dry and wet air at 2200 and 2550°F, 18: 20445(R) (AD-434441)
Pt–Rh–Ti, superconductivity, 18: 21112
Re–Rh–Ti, superconductivity, 18: 21112
Rh–Ag–Ti, superconductivity, 18: 21112
Rh–Ru–Ti, superconductivity, 18: 21112
Rh–Sc–Ti, superconductivity, 18: 21112
Rh–Ta–Ti, superconductivity, 18: 21112
Rh–Ti, superconductivity, 18: 21112
Rh–Ti–V, superconductivity, 18: 21112
Rh–Ti–W, superconductivity, 18: 21112
Rh–Ti–Y, superconductivity, 18: 21112
Rh–Ti–Zr, superconductivity, 18: 21112
Rh–Zr, superconductivity and phase transitions, 18: 21104
RHODIUM ISOTOPES Rh-106
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
RIBONUCLEASE
x-ray scattering cross sections, 18: 20035
RIBONUCLEIC ACID
radiation effects on HeLa, from tritiated-thymidine or -uridine uptake, beta, 18: 19644
radiation effects on synthesis of, 18: 19688
radiation effects on tritiated cytidine uptake by HeLa cell, x, 18: 19599
radiation effects on metabolism of, in mouse blood cells, 18: 19730
RIBONUCLEIC ACID, DESOXY-
effects on syathesis of, 18: 19688
radiation effects on *E. coli* degradation of, x, 18: 19641
radiation effects on HeLa, from tritiated-thymidine or -uridine uptake, beta, 18: 19644
radiation effects on degradation process in, repeated, 18: 19656
radiation effects on rat intestinal and splenic, 18: 19682
radiation effects on metabolism of, in mouse blood cells, 18: 19730
synthesis inhibition by AET and cysteamine in mice, 18: 19524
RIBONUCLEOTIDES, DESOXY-
poly-, radiation effects on content of, in hematopoietic and lymphatic tissues in mice, 18: 19630
RIBOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
ROCKET MOTORS
exhaust plume microwave diagnostics of solid-propellant, 18: 21399
firing of large nuclear, facility design problems in static, 18: 21680
ion, performance of potassium- and sodium-contaminated cesium fuel in, 18: 20626(R) (NP-13800)
ROCKET REACTORS
performance of, design parameter effects on, 18: 21674 (NASA-TN-D-2157)
radiation effects on thermal control materials for, gamma, neutron, and uv, 18: 20603
testing of, facility design problems in static, 18: 21680
thermal conversion in, Brayton-cycle for, 18: 21679
ROCKETS
British Skylark, atmosphere studies with, 18: 21091
firing of stages of large nuclear, facility design problems in static, 18: 21680
ROCKS
analysis for cesium, lithium, and rubidium, spectroscopic, 18: 19853(T) (CEA-tr-R-1711)
RODS
boiling burnout in rod bundle, effects of rod spacing on, 18: 20161 (AEEW-R-178)
heat transfer to liquid metals in cross-flow through bundles of, 18: 20185
ROOTS
effects of deuterium on development of, in corn and pea seedlings, 18: 19662
ion movement into tomato, effects of water movement on, 18: 21723 (TID-18877)
nutrient assimilation from soil by, effects of soil management practices on, 18: 19515 (NP-13796)
RUBBER
dispersion of gases in, quantum isotope effects in, 18: 19961

radiation effects on dielectric properties of, gamma, 18: 20589
radiation stability of, guide to, 18: 20582 (NIRL/R/58)
tensile strength of vulcanized, correlation with network, 18: 21735(T) (SC-T-64-610)
vulcanization of natural, formation of network during, 18: 21735(T) (SC-T-64-610)
RUBIDIUM
determination in minerals and rocks, spectroscopic, 18: 19853(T) (CEA-tr-R-1711)
electron structure, 18: 20548
thermodynamic properties of liquid, at temperatures to 2000°F, 18: 19925(R) (AGN-8065)
use in self-oscillating magnetometers, 18: 20294
RUBIDIUM CHLORIDES
luminescence of F-centers in, 18: 21705(R) (IITRI-1184-12)
RUBIDIUM IONS
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)
RUBIDIUM ISOTOPES Rb-83
energy levels, 18: 21354
RUBIDIUM ISOTOPES Rb-87
alpha reactions (α,n) at 11 to 18 Mev, cross sections and isomer ratios for production of yttrium-90g and -90m in, 18: 21279
nuclear quadrupole moment, 18: 21314
RUSSIAN REACTORS
properties of BR-5, 18: 21683(T) (ANL-Trans-9)
RUTHENIUM ALLOYS
Nb–Ru, thermodynamic properties, paramagnetic susceptibility, and superconducting transition temperature, 18: 20557
Rh–Ru–Ti, superconductivity, 18: 21112
RUTHENIUM ISOTOPES Ru-103
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
RUTHENIUM ISOTOPES Ru-106
content in Clinch and Tennessee Rivers from ORNL, 18: 21697
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
uptake from soil by crop plants, 18: 19515 (NP-13796)
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
RUTHENIUM NITROSYL NITRATES
oxidation by hydrogen peroxide and ozone in nitric acid solutions to form inextractable species, 18: 19924 (AERE-R-4537)
RUTIN
radioprotective effects on rat lungs, gamma, 18: 19807

S

SACCHARIN
radiation effects on rat response to, x, 18: 19667
SACLAY REACTORS
environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)
SAFETY
bibliography on chemical detectors for, 18: 19847 (LAMS-2378(Vol.II))
British nuclear installations act, 18: 20247
danger indicating and warning equipment for Nuclear Research Center at Julich, 18: 20257
in industrial use of radioactive sources, 18: 20253
in radioisotope applications, data and principles for insurance premium calculations for, 18: 20250
radiation in universities, code of practice for, 18: 20245
radiological emergency procedures for laymen involved in accidents involving radioactive materials, 18: 20273
reduction of human errors in man-machine systems, 18: 21719 (SC-R-748)
regulations for radiation use, 18: 20249
SAFETY HAZARDS
from radiation sources, British regulations for, 18: 20242
of nuclear disaster, role of public health offices in, 18: 20252
of x radiation to children, 18: 20263
SALAMANDERS
radiation effects on cell regeneration in, 18: 19553(R) (TID-20513)
SALIVARY GLANDS
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)
SAMARIUM
content and relative abundances in terrestrial materials, 18: 20202
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
neutron reactions (n,γ) at 10 to 20 ev, spectra from, 18: 20388
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from neodymium and promethium by ion exchange, 18: 21707(R) (MLM-1177)
separation from neodymium, 18: 21708(R) (MLM-1178)
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
SAMARIUM ISOTOPES Sm-147
energy levels and gamma spectra of, from Coulomb excitation, 18: 21350
SAMARIUM ISOTOPES Sm-148
energy level at 1.46 Mev, parity and spin of, 18: 21262
SAMARIUM ISOTOPES Sm-152
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
SAMARIUM ISOTOPES Sm-153
beta decay of, gamma spectrum from, 18: 21271
SAMARIUM ISOTOPES Sm-154
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
SAMARIUM NITRATES
separation by solvent extraction using TBP, calculation of cascade stagewise conditions for, 18: 20098 (IS-780)
solubility polytherms of systems with other ceric earths, 18: 20108
SAMPLING
of radioactive liquids, system for, 18: 20134(R) (ORNL-TM-792)
SAP (SINTERED ALUMINUM PRODUCTS)
creep-rupture properties at 700 to 900°F, long-term, 18: 20450(R) (BMI-1661(Del.))
crystal structure of, effects of iron-rich inclusions on, 18: 20562
fabrication of hexagonal APM process tubes for organic reactors, 18: 21569 (NAA-SR-Memo-8121)
thermal expansion of, with various oxide contents, 18: 20517 (EUR-1613.i)
SARCOMAS
radiotherapy of lympho-, pneumonitis induction by x, 18: 19566
SARGASSO SEA
properties of, annual and seasonal variations in biological, chemical, and physical, 18: 21711 (NYO-3140-1B)
SATELLITES
book: *Advances in Space Technology*, 18: 20673
information instruments for, 18: 20412
instruments for, cosmic-ray, 18: 20828
particle and field investigations by U. S., 18: 21090
tracking of, British program for, 18: 21091
SAXTON POWER REACTOR
control of, boric-acid shim, 18: 21652
SCALERS
design of binary and octal, 18: 20301
SCANDIUM
compressibility at room temperature, 18: 20553
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from rare earths and thorium by ion exchange in chloride–thiocyanate media, 18: 20113
SCANDIUM ALLOYS
Nd–Sc, phase diagram, 18: 20520 (IS-841)
Rh–Sc–Ti, superconductivity, 18: 21112
SCANDIUM COMPLEXES
with arsenazo, composition of, 18: 19948
SCANDIUM ISOTOPES Sc-41
energy levels, 18: 21338

SCANDIUM ISOTOPES Sc-44
beta decay of, circular polarization of gamma radiation following, 18: 21309
nuclear structure of, determination of, 18: 21339
SCANDIUM ISOTOPES Sc-45
beta decay of, circular polarization of gamma radiation following, 18: 21309
nuclear magnetic resonance in scandium nitrides, Knight shift and relaxation in, 18: 19980
SCANDIUM NITRIDES
scandium-45 NMR in, Knight shifts and relaxation in, 18: 19980
SCANDIUM OXIDES
spectra of, optical energy gap in, 18: 19986
SCATTERING
amplitude analyticity for four-point function in momentum space, geometric analytic completion for, 18: 21037
amplitude for high-energy, partial-wave contribution from analyticity to, 18: 21043
amplitude for meson (π)-nucleon S-wave, 18: 20937
amplitudes for hyperon-nucleon and nucleon-nucleon, relations between, 18: 20913 (TID-20483)
amplitudes for three-particle two-body Yukawa potential, continuation to complex total angular momentum, 18: 21041
amplitudes for, asymptotic relations between, 18: 20907 (JINR-P-1564)
amplitudes in high energy, renormalization method for, 18: 20983
amplitudes in potential, Watson-Sommerfeld transformation for many-particle, 18: 21040
angular momentum in, Clebsch-Gordon coefficients for, 18: 20991
Bethe-Salpeter structure of three-nucleon potential problem in, with analyticity and unitarity, 18: 20930
calculations for nonstationary multiple Compton, 18: 20920
cross sections for, approximation method based on R-matrix theory, 18: 21304
cross sections of atom-atom, resonance behavior of, 18: 20765
diffusion approximation for multiple, Fokker-Planck, 18: 20924
dipole-quadrupole and retardation effects in atom-atom, at low energies, 18: 20733 (WIS-TCI-41)
effective-core shrinkage at high energies, 18: 21043
electron back-, as function of energy and angle, 18: 20943
formulation of problems in high-energy nuclear, two-body, 18: 21337
influence of fixed centers of, on approach to equilibrium, 18: 21030
matrix for potential, at large complex angular momenta, 18: 21036
measurement of elastic, at very high energies, techniques for, 18: 20897 (CERN-64-6(p.31-48))
model for, tests of one-pion-exchange, 18: 20935
multiple scattering effects in small-angle proton-nucleus, 18: 21242
of neutral particles by crystals, theory of momentum exchange in elastic, 18: 21342
phase shifts in low-energy, negative energy moments of partial-wave, 18: 21054
phase shifts in singular-potential, heuristic Feynman-integral cutoff for weak-coupling limit of, 18: 21049
potential, Green function for barriers in, 18: 21025
potential, with inverse-square attraction, 18: 21055
Regge poles in bootstrap dynamic pseudoscalar meson, SU(3) octet of even-signature, 18: 21042
Regge trajectories for cross sections for nucleon-nucleon, 18: 20936
Regge trajectories for baryons and nucleons in, model for, 18: 20940
Regge trajectories for boson-fermion cross sections with domination by complex conjugate pairs of u-channel trajectories, 18: 20942
resonance overlapping in three-particle final states in S-wave, dispersion theory of, 18: 21044
spin flip and substate excitation in proton inelastic, 18: 21252
statistical mechanics of moderately dense fluids in, theory of irreversible, 18: 20633 (TID-20512)
symmetry breaking in, eightfold-way, 18: 21045
theory of multichannel, minimum principle formulation in, 18: 21050
theory of particle polarization in high-energy physics, 18: 20893 (AFOSR-5287)
wave function spectral representation in momentum space in potential, 18: 21035
SCINTILLATION DETECTORS
design and performance using liquid scintillators, 18: 20335 (NP-13840)
design for metabolic studies using gamma emitters, 18: 20346
design for 0.1- to 2-Mev gamma spectrometer, 18: 20411
design of 4π, for beta counting, 18: 20380
design of, with high spatial resolution, 18: 20353
development for detection of beta particles from tritium, 18: 19887
light pipes for, efficiency of, 18: 20399
performance as 4π beta spectrometers, 18: 20360
performance in coincidence, for gamma spectroscopy, 18: 20331 (KR-64(Sect.X))
performance of helium-filled, for neutrons, 18: 20398
performance of organic, for discrimination of gamma rays and neutrons 18: 20350
properties of lithium-drifted germanium, 18: 20375
quenching of liquid, use x and γ sources for, 18: 20352
use in measuring slowing-down time of neutrons to cadmium edge, 18: 21148
use in proton scattering polarization analysis, 18: 20383
use of liquid coincidence, in determination of barium-137, 18: 19891
use of liquid scintillation, in determination of tritium, 18: 19890
SEA WATER
analysis for fission products and trace elements, 18: 19837(R) (MIT-905-1)
analysis for trace elements, 18: 21712(R) (NYO-10065)
carbonate formation by marine mollusks and bacteria in, 18: 19520(R) (TID-20499)
desalination of, economic implications of nuclear energy for, 18: 21665
distillation of, design study of heavy-water reactors for, 18: 21632 (DP-866)
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
SEALING MATERIALS
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
SEALS AND GLANDS
design for coupling fueling machine to reactor standpipe, 18: 21587(P)
development of high-pressure pump, 18: 20133(R) (NYO-9802)
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)
SEED
radiation effects on development of nicotiana, 18: 19690
SEEDLINGS
effects of deuterium on root development in corn and pea, 18: 19662
radiation effects on cotton, gamma, 18: 20418
SEISMIC WAVES
effects of underground explosion on structures, 18: 20127 (UCRL-7773)
propagation of surface, from high-altitude explosions, 18: 21081
SEISMOLOGY
data from Coast and Geodetic Survey in nuclear detonation series, 1961 to 1963, 18: 20201 (NP-13867)
excitation of seismic surface waves by atmospheric nuclear explosions, 18: 21081
SELENIUM ISOTOPES Se-77
neutron reactions (n,γ) with, sum-coincidence studies of gamma cascades from, 18: 21329
SEMICONDUCTOR DETECTORS
amplifiers for, design of fast-coincidence pre-, 18: 20356
amplifiers for, design of low-noise, 18: 20366
design and operation characteristics, 18: 20349
design and preparation of multiple-junction, for high-energy particles, 18: 20417(P)
design for charged-particle analyses in aurorae, 18: 20364
drifting of, automatic apparatus for lithium-, 18: 20344 (UCRL-11261)
energy resolution for nuclear particles, 18: 20395
performance for high-resolution gamma spectroscopy, 18: 20374
performance for low-energy gamma spectroscopy, 18: 20373
performance in cyclotron scattering chambers, 18: 20688
performance in fast-neutron recoil spectrometers, 18: 20365
performance of silicon surface-barrier, 18: 20354
performance of silicon surface-barrier, 18: 20355
performance of silicon and germanium, for fast neutrons and gamma rays, 18: 20413

properties and uses, 18: 20376
properties in high-energy particle spectrometry, 18: 20410
properties in secondary beam profile measurement, 18: 20327 (BNL-7880)
properties of commercial, 18: 20377
properties of lithium-drifted germanium, 18: 20375
properties of, survey, 18: 20334 (KR-64(Sect.XXXI))
radiation effects on silicon, electron and neutron, 18: 20357
surface effects in lithium-drifted silicon, 18: 20326 (BNL-7853)
use as alpha and neutron counters in column separation of transplutonic elements, 18: 20101 (UCRL-11300)
use in particle spectrometer, 18: 20330 (CEA-2388)
use of cadmium sulfide, for gamma dose rate determinations, 18: 20351
use of pairs of, for analyzing distributions from nuclear reactions, 18: 21250

SEMICONDUCTORS
electron emission from electrodes of, 18: 20152
magnetic field and optical radiation effects on, device for measuring, 18: 20307
potential energy for, 18: 20829(R) (AD-429503)
superconducting transitions in, 18: 21102
superconducting transitions in, 18: 21102
surface contamination of, use of radioisotopes for detection of, 18: 20420

SEPARATION PROCESSES
development of radiochemical, 18: 20044

SHEEP
radiation effects on mouse immunity to erythrocytes of, continuous gamma, 18: 19623

SHELLS
analysis of cylindrical, clamped along oblique contour, 18: 21733(T) (ORNL-tr-19)
impact testing of spherical, 18: 20195(R) (SC-DC-64-383)

SHELTERS
design of dual-use military, 18: 20197 (NAVDOCKS-P-310)

SHIELDING
fabrication of flexible, for protective garments, 18: 21547(P)
fabrication of flexible lead, 18: 21548(P)
facility description for studies at Battelle, 18: 21543 (BMI-1384)
for whole-body counting room, 18: 20337 (NYO-2553-1)
from radiation in space vehicles, 18: 20240
neutron albedo on slab, transport solution for, 18: 21134 (TID-20540)

SHIELDING MATERIALS
gamma scattering and transport in, Monte Carlo methods for calculating, 18: 20932

SHIPPING
regulations for radioactive material, 18: 20248

SHIPPINGPORT PRESSURIZED WATER REACTOR
development and operation, Oct. 24, 1963–Jan. 23, 1964, 18: 21643(R) (WAPD-MRP-107)

SHOCK TUBES
design, 18: 20119 (ARL-64-5)
wave propagation in conical, analysis of, 18: 20647

SHOCK WAVES
hydrodynamics of, tensor artificial viscosity for two-dimensional Lagrangian system, 18: 20635 (UCRL-7205-T)
in granite from Hardhat event, calculation, 18: 20125 (UCRL-7762)
microwave studies of electrically driven, in gases, 18: 21448
motion in collision-free plasma in magnetic field, 18: 21386 (NYO-10434)
motion in steady two-dimensional MHD flow, 18: 20630 (NYO-10436)
production in deuterium–tritium mixtures by accelerated solid particles, attainability of fusion temperatures from, 18: 21418
production of very high-pressure, in metals, 18: 20454 (LADC-5561)
propagation in conical tubes, analysis of, 18: 20647
propagation in plasma pinch, compression effects of, 18: 21523
properties at high pressures, theory of, 18: 21728 (UCRL-7307-T)
properties of, produced by condenser discharge in gas tube, 18: 20629 (NP-13850)
stability of MHD, in conducting fluids, 18: 20649
stability of step, interpretation of criterion for, 18: 20624 (LADC-5814)

SILICATE ROCKS
analysis of, quantometric and spectrographic, 18: 19910

SILICATES
analysis for hafnium, thorium, titanium, and zirconium, simultaneously, spectrographic, 18: 19912
content in Sargasso Sea, annual and seasonal variations in, 18: 21711 (NYO-3140-1B)
radiation effects on thermal control coatings of, in nuclear spacecraft, 18: 20603

SILICIDES
properties as coatings for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)

SILICON
cosmic-ray reactions with, in stony meteorites, production of helium-3 and neon-21 by, 18: 20204
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in iron, activation, 18: 20425
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in zirconium diboride, 18: 19882
effects on spalling of niobium at high temperatures, 18: 20474 (TID-12794)
electron emission from electrodes of semiconducting, 18: 20152
performance in surface-barrier radiation detectors, 18: 20354
performance of lithium-drifted, for radiation detection, 18: 20355
performance of lithium-drifted, for low-energy gamma detection, 18: 20373
properties as high-energy meson and proton spectrometer, 18: 20410
properties as semiconductor detector, 18: 20376
properties of semiconductor detectors of, 18: 20377
radiation effects on, in surface-barrier detectors, 18: 20357
surface contamination of, use of radioisotopes for detection of, 18: 20420
x-ray scattering by single-crystal, small-angle, 18: 20555
xenon-125 ranges at 20 to 80 kev, 18: 20812

SILICON CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
SiC–UC, performance in gas-cooled reactors, 18: 21659

SILICON IONS
spectral locations and widths in plasma, 18: 21409(T)

SILICON ISOTOPES Si-28
bremsstrahlung reactions (γ,p) at 15 to 30 Mev, energy distribution of protons from, 18: 21325

SILICON ISOTOPES Si-32
beta spectrum, 18: 20023 (TID-20510)

SILICON JUNCTIONS
drifting of, automatic apparatus for lithium-, 18: 20344 (UCRL-11261)
energy resolution of n-p, for nuclear particles, 18: 20395
performance as fast-neutron and gamma-ray detectors, 18: 20413
surface effects in lithium-drifted, 18: 20326 (BNL-7853)

SILICON OXIDES
additive effects on fabrication and properties of tungsten, 18: 20443(R) (AD-416199)
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
radiation effects on low-temperature dielectric relaxation in fused, neutron, 18: 20616
sorption properties for cobalt phenanthroline, 18: 19898
sorptive properties of gel of, for radon, 18: 19940(T) (SC-T-64-613)

SILICON SYSTEMS
Cr–Cu–Fe–Mn–Ni–Si, corrosion of Incoloy 800 by superheated steam, 18: 21668(R) (GEMP-274)
Cr–Mo–Si, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)
Cr–Si–Ti, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)

SILICONES
radiation effects on thermal control coatings of, in nuclear spacecraft, 18: 20603

SILTS
radioactivity of Columbia River, 18: 20219

SILVER
determination in nucleic acids, activation, 18: 19892

determination of, optimum sample position in activation, 18: 19906
electron diffraction scattering by thin foils of, analyzing system for, 18: 20670
hydrogen ion reactions at 260 kev, uv radiation emission in, 18: 20781
preparation of porous membranes of, for ultrafiltration, 18: 19934 (NP-13874)
proton reactions at 260 kev, uv radiation emission in, 18: 20781
proton reactions at 660 Mev, angular distribution of fragments from spallation, 18: 21229
proton spallation at 660 Mev, 18: 21230
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
sputtering by argon at 40 to 80 kev, angular and energy distribution from, 18: 20783
stacking-fault energy, 18: 20550

SILVER ALLOYS
Rh–Ag–Ti, superconductivity, 18: 21112

SILVER BROMIDES
sensitivity of crystals of, in ionographic emulsions, 18: 20336 (NP-13851)

SILVER HALIDES
performance as nuclear emulsions, 18: 20414

SILVER IONS
association with chloride in liquid cesium, lithium, and potassium nitrate mixtures, constants for, 18: 19975

SILVER ISOTOPES Ag-108
beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))

SILVER ISOTOPES Ag-110
beta decay of polarized, produced by capture of polarized neutrons, 18: 21201 (KR-64(Sect.XXVIII))
beta decay of, circular polarization of gamma radiation following, 18: 21309

SILVER ISOTOPES Ag-111
uptake by dogs, effects on skin homografts, 18: 19605

SILVER URANATES
preparation and properties, 18: 20012

SINTERING
mechanisms of, in hydrogen and steam, 18: 20489

SIOUX FALLS POWER REACTOR
dynamics of, simulator studies on, 18: 21628 (ACNP-63033)

SKELETON
calcium-45 and strontium-90 uptake by miniature pig, age effects on discrimination in, 18: 19539
strontium-90 deposition kinetics in, of man, 18: 20235 (NP-13868)
strontium-90 uptake by mammalian, effects of diet on, 18: 19533

SKIN
homografts in mice, effects of bacterial infection on, 18: 19511
radiation effects on homografts of dog, from bismuth-206 and silver-111, 18: 19605
radiation effects on mitosis in malignant and nonmalignant hyperplasia of mouse, 18: 19704
radiation effects on, in accidental exposure, 18: 19706
radiation effects on, in telegammatherapy using cesium-137, 18: 19716
radiation effects on rat, protective effects of cystamine and cysteamine against, x, 18: 19784
radiation protection of, in radiotherapy using barium, bismuth, lead and zinc pastes, 18: 19832
radiation used with cortisone on, effects on homografts in rabbits of, x, 18: 19613(T)
radioinduced chromosomal aberrations in cultures of human, x, 18: 19563
radioinduced ulcers on, in x-ray therapy of skin carcinomas, 18: 19714

SKIN DISEASES
radiotherapy with ultraviolet or x radiation, reticulocyte increases in peripheral blood in, 18: 19712

SLURRIES
flow of, heat transfer in two-phase, 18: 20171 (TID-7694(p.18-23))

SNAILS
analysis for trace amounts of sodium, radiochemical, 18: 19841 (CONF-187-112)
radiosensitivity of, effects of age on, 18: 19698

SNOW
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218

SODIUM
analysis for carbon in primary cooling system of HNPF, 18: 21637 (NAA-SR-Memo-8214)
analysis for oxygen, amalgamation method for, 18: 19919
analysis of liquid, for sodium oxide, 18: 21698(R) (ANL-6860)
boiling of, vapor volume fractions in, 18: 20170 (TID-7694(p.11-17))
corrosive effects on niobium and vandium alloys, 18: 21698(R) (ANL-6860)
corrosive effects on AISI 316 SS, Hastelloy C, Incoloy, molybdenum, and Timken 16-25-6 at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
determination in nucleic acids, activation, 18: 19892
determination of trace amounts of, in biological materials, radiochemical, 18: 19841 (CONF-187-112)
determination of trace amounts of, in snails, radiochemical, 18: 19841 (CONF-187-112)
effects on cesium fuel for ion engines, 18: 20626(R) (NP-13800)
effects on reactor components, Large Component Test Loop heat transfer system for studying, 18: 21570 (NAA-SR-Memo-8217)
electron structure, 18: 20548
exchange in chelating ion resin, self-, 18: 19972
flow from upper plenum of 200-Mw(e) SGR, hydraulic analysis of, 18: 21639 (NAA-SR-Memo-9241)
flow of liquid, mixing tee design and performance for, 18: 21567 (NAA-SR-Memo-7485)
heat transfer in liquid, burnout problems in, 18: 20193
heat transfer of boiling, forced- and natural-circulation, 18: 20160(R) (AD-423679)
heat transfer of boiling, forced- and natural-circulation, 18: 20166(R) (NP-13810)
heater design for, electron-bombardment, 18: 20132 (NAA-SR-Memo-8289)
neutron resonance scattering by, 18: 21698(R) (ANL-6860)
performance as reactor coolant, evaluation of, 18: 20192
performance as reactor coolant, reliability of, 18: 20194
physical properties of liquid, review, 18: 20516 (EUR-599.d)
pump development for liquid, 18: 20131 (NAA-SR-Memo-2368(Rev.))
sorption by Dowex 50 X8 in ammonia, effects of anions on, 18: 19837(R) (MIT-905-1)
technology of liquid, developments in, 18: 20464
transport mechanisms in rat stomach, 18: 19521 (USNRDL-TR-716)

SODIUM ALLOYS
K–Na, chemistry and impurity analysis of reactor-coolant, 18: 21661
K–Na, physical properties of liquid, review, 18: 20516 (EUR-599.d)
K–Na, purification by cold-trapping, 18: 21657
K–Na, vapor pressures and activities of sodium and potassium in, 18: 20569

SODIUM CHLORIDES
analysis for chlorine-38 and sodium-24, calculation method for, 18: 20069
corrosive effects on austenitic stainless steel, effects of surface grinding on, 18: 20470 (CONF-492-1)
crystal lattice vibrations of, eigenvectors for, 18: 21726 (TID-20487)
effects of excess ingestion of, on induction of hypertension in man and rats, genetic control of, 18: 21702 (BNL-7971)
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481
radiation effects on electric conductivity of, effects of impurities on x, 18: 20588
radioinduced coloration and volume expansion in, 18: 20598
thermal conductivity of rock salt, 18: 20530 (UCRL-6894(Rev.II))
x-ray scattering cross sections, 18: 20035
NaCl–$NaClO_4$, osmotic pressure, 18: 19837(R) (MIT-905-1)

SODIUM CHROMATES
corrosion inhibition by, stainless-steel, 18: 20477

SODIUM ELECTRODES
potentials in tetrahydrofuran solution of sodium perchlorate, 18: 19837(R) (MIT-905-1)

SODIUM FLUORIDES
radioinduced color centers in crystals of, temperature dependence of x, 18: 20039 (COO-1044-14)
LiF–KF–NaF, chronopotentiometry and voltammetry of iron in liquid, 18: 19966

SODIUM HALIDES
effects on oxidation of uranium dioxide, 18: 19943
SODIUM IODIDES
luminescence efficiencies of thallium-activated, gamma, 18: 20076
performance in scintillation gamma spectrometers, 18: 20331 (KR-64 (Sect.X))
SODIUM IONS
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)
SODIUM ISOTOPES Na-22
beta decay of, circular polarization of gamma radiation following, 18: 21309
beta decay of, ratio of electron capture to positron emission in, 18: 21245
decay scheme of, removal of fictitious cascades from, 18: 21251
scintillator quenching by, 18: 20352
SODIUM ISOTOPES Na-23
energy levels of, suitability of collective model for predicting excited, 18: 21327
SODIUM ISOTOPES Na-24
beta decay, 18: 21306
beta decay of, circular polarization of gamma radiation following, 18: 21309
beta decay of, meson exchange effects in gamma circular polarization following, 18: 21269
determination in organic reactor coolant, 18: 21553 (NAA-SR-Memo-7771)
SODIUM NITRATES
effects on oxygen balance in bone marrow and brain of rabbits, 18: 19801
radiation effects on, 18: 20080
x-ray scattering cross sections, 18: 20035
SODIUM OXIDES
determination in liquid sodium, 18: 21698(R) (ANL-6860)
SODIUM PERCHLORATES
aquo ions in, half-wave potential shift of, 18: 21712(R) (NYO-10065)
$Cu(ClO_4)_2$–$NaClO_4$, osmotic pressure, 18: 19837(R) (MIT-905-1)
NaCl–$NaClO_4$, osmotic pressure, 18: 19837(R) (MIT-905-1)
SODIUM REACTOR EXPERIMENT
control rod performance, 18: 21571 (NAA-SR-Memo-9003)
coolant pump design and performance, 18: 21571 (NAA-SR-Memo-9003)
coolant purification for, hot- and cold-trap performance for, 18: 21571 (NAA-SR-Memo-9003)
core II performance in, 18: 21571 (NAA-SR-Memo-9003)
core III nuclear analysis for, 18: 20455 (NAA-SR-Memo-9406)
fuel element design and performance, 18: 21571 (NAA-SR-Memo-9003)
fuel element thermal performance in core III, 18: 21556 (NAA-SR-Memo-9431)
hydraulic design of SRE-PEP core III variable orifice, 18: 21572 (NAA-SR-Memo-9253)
SODIUM SULFIDES
reactions with molybdenum to form molybdenum sulfide, 18: 20001
SOILS
age of humus podzols, carbon-14 determination of, 18: 20223
analysis for moisture, neutron moderation method for, 18: 19905
antimony-125 content, 18: 19516
background radiation in, effects on Streptomyces, 18: 19560
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
fallout uptake by, in England, 18: 20208 (AERE-R-4415)
fission product contamination of, by fallout from radiological warfare, 18: 19515 (NP-13796)
SOLAR BATTERIES
development, 18: 20879
development, 18: 20880
SOLAR FLARES
cosmic radiation in, origin of, 18: 20723
SOLAR RADIATION
book: *Cosmic Rays, Solar Particles and Space Research*, 18: 20821
interactions with geomagnetic fields, 18: 20722
neutrino flux and elastic scattering, limits on, 18: 20713
origin, 18: 20827
production of, cosmic radiation increase due to flare, 18: 20723
properties of solar wind, 18: 20717
protons in, carbon-14 production in atmosphere by neutrons from, 18: 20817
relation to cosmic radiation intensity variations, 18: 20814 (AD-434540)
research progress on, 18: 21712(R) (NYO-10065)
spectrum of flare-produced, 18: 21094
SOLENOIDS
design of water-cooled high-flux, 18: 20129 (ARL-64-29)
electric conductivity of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
performance of water-cooled, for plasma containment, 18: 21539
properties of superconducting, compensated to sixth order, 18: 20298
SOLIDS
photon-electron interactions in, "photon-drag" effect in, 18: 21407
radioinduced color centers in, research progress on x, 18: 20627(R) (NP-13815)
SOLUTIONS
analysis of industrial, quantometric and spectrographic, 18: 19910
radiation chemistry of aqueous, calorimeters for study of, 18: 20083
radiolysis of dilute inorganic, 18: 20037 (BNL-6978)
SOLVENT EXTRACTION PROCESSES
cascade stagewise conditions for separation of rare earths by TBP, calculation, 18: 20098 (IS-780)
developments in, review of, 18: 20103
performance of, for separating nitric acid using long-chain amines, effects of nitrates on, 18: 20107
use in radiochemistry, review of, 18: 20085
SOUND
human response to, from ultrasonic devices, 18: 21704 (HW-SA-3028)
pressure levels of, produced by ultrasonic devices, 18: 21704 (HW-SA-3028)
propagation in magnetic field, wavelength dependence in, 18: 20643
velocity in helium-3 and -4 mixtures, 18: 21115
SOUTH AFRICAN RESEARCH REACTOR
control of Safari I, instrumentation for, 18: 21686
SOVIET UNION
virology studies in, 18: 19508(T) (JPRS-23956)
SPACE
book: *Cosmic Dust*, 18: 20720(T)
book: *Cosmic Rays, Solar Particles and Space Research*, 18: 20821
research program on, British, 18: 21091
spectra of interstellar, 18: 21089
starlight polarization in, 18: 20725
SPACE FLIGHT
book: *Advances in Space Technology*, 18: 20673
Van Allen proton time-integrated flux for low-acceleration trajectories, 18: 20816
SPACE POWER UNIT REACTOR
turbogenerator liquid-potassium bearing tests, 18: 21666 (APL-TDR-64-27)
SPACE VEHICLES
book: *Advances in Space Technology*, 18: 20673
information instruments for, 18: 20412
launch information tabulation to Feb. 1962, 18: 20673
meteoroid bombardment effects on, simulation of, 18: 20707
mission performance evaluation, 18: 21674 (NASA-TN-D-2157)
nuclear-powered, use of thermionic elements in, 18: 20837
particle and field investigations using U. S., 18: 21090
power supplies for, properties of Brayton-cycle, 18: 21679
propulsion of, survey of requirements and prospects of nuclear reactors for, 18: 21678
propulsion systems for, effects of propellant stream velocity distribution on performance of power-limited, 18: 20639
radiation effects on electronics of nuclear, 18: 20304
radiation shielding in, 18: 20240
reactor shielding for, design of lithium hydride tungsten, 18: 21676 (SSD-TDR-63-217)
SPALLATION
angular correlations in proton, 18: 21229
angular correlation analysis for, 18: 21230
SPARK DETECTORS
design of large, with metal mesh electrodes, 18: 20370

development, 18: 21712(R) (NYO-10065)
development of multi-wire, with ferrite memory cores, 18: 20371
technology of, 18: 20378
use in elastic scattering experiments at high energy, 18: 20897 (CERN-64-6(p.31-48))
use in proton synchrotron experiments, 18: 20401
use of coaxial symmetrical flow, for carbon dioxide and thermal neutrons, 18: 20348

SPARK SHADOWGRAPH PHOTOGRAPHY
light source design for, 18: 21717 (SC-R-64-119)

SPECTROMETERS
charged-particle intensity distribution in line focus of, wave optics of, 18: 20407
design and applications of particle, using semiconductor detectors, 18: 20330 (CEA-2388)
design of $\pi\sqrt{2}$, 18: 21313
design of solid-state, for charged-particle studies in aurorae, 18: 20364
development of high-transmission bent-crystal, 18: 19837(R) (MIT-905-1)
irradiation of wet biological systems using ESR, 18: 20293

SPECTROPHOTOMETRY
cell design for low-temperature studies of radioinduced color centers in alkali metal halide crystals, 18: 20622 (COO-1044-16)

SPECTROSCOPY
conference on applications, equipment, and techniques in, 18: 20676
developments in absorption, review of, 18: 19860
developments in emission, review of, 18: 19863
electron shell order in ionized atoms, 18: 20758

SPERM
radiation effects on genetic response of Drosophila, neutron and x, 18: 19647
radiation effects on human, after accidental exposure, 18: 19648
radiation effects on chicken, effects on fertility and hatchability, 18: 19664

SPERMATOGENESIS
radiation effects on cytochemistry of Stenobothrus, x, 18: 19615

SPHERES
electric breakdown between planes and, in vacuum, 18: 20138
impact testing of hollow, 18: 20195(R) (SC-DC-64-383)
rotation in conducting viscous fluid in magnetic fields, 18: 20664

SPINAL CORD
radiodiagnosis using Thorotrast, nervous system injuries from, 18: 19659

SPLEEN
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)
radiation and vaccination effects on mouse, x, 18: 19740
radiation effects on DNA in rat, 18: 19682
radiation effects on iron-59 uptake by mouse, x, 18: 19594
radiation effects on phosphonucleoside content of rat, 18: 19702
radiation effects on extracellular space in, 18: 19718
radiation effects on mouse mortality, effects of age on cells from, on, 18: 19727
radiation effects on leukocyte glycogen content in mouse, when used with antigens, x, 18: 19741
radiation effects on proteolysis in mouse, x, 18: 19744
radiation effects on mouse, protective effects of homologous cells against, 18: 19767
use in assaying viable cells in transplanted lymphoma suspensions, 18: 19671

SPUTTERING
mechanisms of, by rare gas ion, 18: 20745

STAINLESS STEEL
analysis for oxygen, activation, 18: 19886
carburization surveillance of HNPF core materials, 18: 21637 (NAA-SR-Memo-8214)
compatibility of type 321, with thorium and uranium borides and carbides, 18: 20450(R) (BMI-1661(Del.))
corrosion by cesium at 750°C, 18: 20873
corrosion by sodium at 1200°F, 18: 20472 (NAA-SR-Memo-9340)
corrosion by steam–water mixtures, 18: 20182 (TID-7694(p.108-49))
corrosion by superheated steam, 18: 21668(R) (GEMP-274)
corrosion by uranium hexafluoride up to 1000°C, 18: 20469 (CEA-2385)
corrosion cracking in dilute chloride solutions, effects of acidity on, 18: 20471 (CONF-492-2)
corrosion cracking in uranyl sulfate solutions containing copper sulfate and sulfuric acid, 18: 20477
development and properties of high-strength high-temperature corrosion-resistant AFC-77, 18: 20446 (ASD-TDR-63-766)
dissolution of, electrolytic, 18: 20115
electric breakdown between plane-sphere electrode geometry of, in vacuum, 18: 20138
electric conductivity of solenoids of, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
galling of, testing of coatings for protection against, 18: 20134(R) (ORNL-TM-792)
joining to beryllium, development of brazing method for, 18: 20134(R) (ORNL-TM-792)
radiation effects on tensile properties of pressure tube of type 347, effects of annealing on fast neutron, 18: 20450(R) (BMI-1661(Del.))
tensile properties of annealed and cold-worked tubular, at 20°C, 18: 21706(R) (KR-66)
stainless steel–UO_2, electrolytic dissolution of, 18: 20115

STAINLESS STEEL (AUSTENITIC)
corrosion cracking in dilute sodium chloride, effects of surface grinding on, 18: 20470 (CONF-492-1)

STARCHES
radiation effects on color of iodoacetic acid mixture and use as chemical dosimeter, 18: 19751

STARK EFFECT
on hyperfine structure of potassium fluoride, 18: 20762

STARS
gravitational collapse of massive, radiation from, 18: 20715
helium and hydrogen burning in red giant, 18: 20727
light from, interstellar polarization of, 18: 20725
pulsation of envelopes of RR Lyrae and Cepheid type, 18: 20716
spectra of main-sequence B, comparison of calculated and observed continuous, 18: 20714
spectra variations with temperature, 18: 21089
x-ray emission by neutron, 18: 20711

STATISTICS
analytic solution of the Percus-Yevick equation, 18: 21029
of double isotope liquid scintillation counting by internal standard technique, 18: 19872
of electrons in screening constant model of complex atoms, 18: 20731 (RM-3803-AEC)
random distribution function for branching process, convergence of, 18: 20892 (AD-434059)
theory for variance in background and optimum counting times in mass spectrometry, 18: 19878
theory of broadening of spectral lines in plasma, generalization of, 18: 21405

STEAM
corrosive effects on chromium–nickel alloy and other alloys, 18: 21668(R) (GEMP-274)
separation from water, development of centrifugal separators for, 18: 20128(R) (ACNP-64021)
steam–water, flow in vertical tubes, pressure drops in, 18: 20164 (EURAEC-1004)

STEARIC ACID
radiation effects on uptake of, by lipids in human bone marrow, 18: 19552(R) (NYO-2769-1)

STEEL
corrosion by ammoniated and pure water at 230 and 315°C, 18: 21706(R) (KR-66)
crystallography of martensitic, 18: 20537(T,R) (EURAEC-977)
ductility of A302 B, 18: 20528(R) (SWRI-1228-18)
elastic moduli of 4340, at 0 to 1600°F from ultrasonic measurements, 18: 20196 (UCRL-7326)
fabrication and mechanical properties of A105-II and A302-B, 18: 20457(R) (SWRI-1228-19)
fabrication and properties of extruded and forged, 18: 20447(R) (ASD-TR-7-797(IX))
fatigue properties of A302 B, with stressing at ambient temperature and stress relieving, 18: 20528(R) (SWRI-1228-18)
impact properties of weld heat-affected A212 B, 18: 20529 (TID-20463)

microstructure of weld heat-affected A212 B, 18: 20529 (TID-20463)
neutron attenuation by, from 14-Mev source, 18: 19821
radiation effects on dimensional stability of hardened, neutron, 18: 20584 (SC-R-64-120)
radiography of thin, ytterbium-169, 18: 20425
welding of reactor, by electroslag techniques, 18: 20488(T,R) (EURAEC-970)

STELLARATORS (C)
electron temperatures in, 18: 21378 (MATT-251)
oxygen ion concentrations, 18: 21378 (MATT-251)
radiation and power balance in, impurity, 18: 21377 (MATT-247)

STERILITY
radioinduced in Anopheles, gamma, 18: 19654
radioinduced in human males after accidental exposure, 18: 19648
radioinduced in mice, protection against, using serotonine, 18: 19711

STILBENE
alpha and electron excitation of, pulse-height ratios for, 18: 20408

4,4'-STILBENEDIOL, α,α'-DIETHYL-
radiosensitivity effects, 18: 19799

STOCHASTIC METHODS
theoretical-numerical basis of the stochastic number theory, 18: 21734(T) (ORNL-tr-42)

STOMACH
bioelectrogenic mechanisms in rat, ionic relation of, 18: 19521 (USNRDL-TR-716)
photoscanning of, after injection of labeled colloidal albumin, 18: 19813 (CONF-164-11)

STRATOSPHERE
radioactivity in, artificial, 18: 21082
radioisotope content in, production mechanisms for, 18: 21080
wind temperature and isobaric height conditions during IGY, 18: 20619 (TID-20511)

STREPTOMYCES
radiation effects on, background, 18: 19560

STRESS ANALYSIS
of cylindrical shell clamped along oblique contour, 18: 21733(T) (ORNL-tr-19)

STRONTIUM
contamination in mineral analyses using laboratory glassware, 18: 19888
determination of ratio to calcium in powder samples, x-ray-fluorescence, 18: 19849 (PG-Report-583)
incorporation in calcium fluoride and phosphate precipitates, 18: 19949
separation from fission products by sorption on ferric hydroxide, 18: 20102 (UJV-850/63)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104

STRONTIUM COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946

STRONTIUM ISOTOPES Sr-83
beta decay scheme and gamma spectra, 18: 21354

STRONTIUM ISOTOPES Sr-86
content in Hawaiian lavas, 18: 20216

STRONTIUM ISOTOPES Sr-87
content in Hawaiian lavas, 18: 20216

STRONTIUM ISOTOPES Sr-88
energy levels of, spins and parities of, 18: 21208 (NP-13841)

STRONTIUM ISOTOPES Sr-89
content in blood plasma of cows and goats, method for establishing, 18: 19541
separation from water by chemical precipitation, 18: 20266
uptake from soil by crop plants, effects of calcium content of soil on, 18: 19515 (NP-13796)

STRONTIUM ISOTOPES Sr-90
content in animals and plants of Lapland, 18: 20213
content in Clinch and Tennessee Rivers from ORNL, 18: 21697
content in cyclonic storm precipitation, variations in, 18: 20215
content in English plants, soil, and water, 18: 20208 (AERE-R-4415)
content in food products, effects of cooking on, 18: 20238(T) (JPRS-24139)
content in milk in England, 18: 20208 (AERE-R-4415)
content in milk in German Federal Republic, Sept. 1961 to Sept. 1962, 18: 19809
content in samples of rain water, milk, and human bone collected in New Zealand, 1963, 18: 20234(R) (NP-13859)
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)
determination in fallout by ion exchange, 18: 19880
maximum permissible intake values of, for constant intake by man, 18: 20235 (NP-13868)
metabolism kinetics of, in man, 18: 20235 (NP-13868)
radiation effects on rat teeth uptake of, x, 18: 19655
separation from water by chemical precipitation, 18: 20266
sorption by clay materials from radioactive solutions, 18: 21696
source for whole-body irradiation, design of 24-curie, 18: 19819
uptake by mammalian skeleton, effects of diet on, 18: 19533
uptake by skeleton in miniature pigs, age effects on calcium-45 discrimination in, 18: 19539
uptake from soil by crop plants, effects of calcium content of soil on, 18: 19515 (NP-13796)
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516

STRONTIUM NIOBATES
luminescence of, self-activated, 18: 20060

STRONTIUM OXIDES
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))

STRONTIUM PHOSPHATES
preparation and properties of ortho-, 18: 19954

STRONTIUM SULFIDES
vaporization of, thermodynamic data for, 18: 19939 (WADD-TR-60-782 (Pt.XXI))

STRONTIUM TANTALATES
luminescence of, self-activated, 18: 20060

STRONTIUM TITANATES
crystal dynamics and phase transitions, 18: 19992
superconducting transitions in, 18: 21102
superconducting transitions in, 18: 21102

STRUCTURES
design of dual-use military shelters, 18: 20197 (NAVDOCKS-P-310)
prediction and control of leakage through cracks and capillaries in reinforced concrete buildings used to house reactors, 18: 21555 (NAA-SR-Memo-9429)
seismic effects of underground explosions on, 18: 20127 (UCRL-7773)

STYRENE POLYMERS
light scattering by aqueous suspension of, 18: 20627(R) (NP-13815)
lithium isotope separation factor in ion exchange in solution of, 18: 20434
radioinduced formation from α-methylstyrene by electrons, 18: 20070
radioinduced graft polymerization with cotton, thermal stress properties of products in, 18: 20084
radioinduced graft polymerization of monomers onto, 18: 20096(R)

STYRENES
α-methyl-, radioinduced polymerization, 18: 20070

SUCCINIC ACID, MERCAPTO-
complexes with uranium, free energy of formation and spectra of, 18: 19947

SULFATE COMPLEXES
with manganese in perchlorate solutions, paramagnetic resonance studies of, 18: 21730 (UCRL-10446)

SULFIDES
lead isotopic ratios in Sudbury, Ontario, gas source mass spectrometry of, 18: 20203

SULFONE, ETHYL VINYL
radioinduced copolymerization with β-cyanoethyl acrylate, 18: 20450(R) (BMI-1661(Del.))

SULFONIC ACIDS
flavonol-2'-, analytical uses for spectrophotometric determination of zirconium, 18: 19884

SULFONIUM COMPOUNDS
solubility in heavy and light water at 25°C, activity coefficients of, 18: 19837(R) (MIT-905-1)
t-butyldimethylsulfonium-α-t-fluoroborate, solvolysis in sulfuric acid solutions at 99.2°C, 18: 19837(R) (MIT-905-1)

t-butylmethylphenylsulfonium methylsulfate, preparation and nuclear properties, 18: 19837(R) (MIT-905-1)
SULFUR
cosmic-ray reactions with, in stony meteorites, production of helium-3 and neon-21 by, 18: 20204
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
dissociation energy of S_2, 18: 19939 (WADD-TR-60-782(Pt.XXI))
SULFUR DIOXIDES
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
SULFUR ISOTOPES S-31
energy levels, 18: 21210 (PAN-288)
SULFUR ISOTOPES S-32
alpha reactions (α,γ) at 2.2 to 3.2 Mev, 18: 21264
deuteron reactions (d,He-3) at 12.8 Mev, angular distribution for, 18: 21210 (PAN-288)
gamma reactions (γ,n) with, neutron energy spectra from, 18: 21257
SULFUR ISOTOPES S-34
alpha reactions (α,γ) at 2.2 to 3.2 Mev, 18: 21264
SULFUR ISOTOPES S-35
beta spectra of, Fermi plots of, 18: 20360
content in stratosphere, production mechanisms for, 18: 21080
incorporation from sulfate solutions in irradiated comea tissue, 18: 19708
uptake by mice of AET labeled with, 18: 19774
SULFUR OXIDES
dissociation energy of SO, 18: 19939 (WADD-TR-60-782(Pt.XXI))
SULFURIC ACID
reactions with uranium dioxide, effects of halides on, 18: 19943
voltammetry of cerium, chromium, manganese, and vanadium in, using pyrolytic graphite electrode, 18: 19967
$CuSO_4$–H_2SO_4–UO_2SO_4, corrosive effects on stainless steel, 18: 20477
H_3PO_4–H_2SO_4, voltammetry of cerium, chromium, manganese, and vanadium in, 18: 19967
SUN
surface of, description, 18: 20721
ultraviolet radiation in upper atmosphere from, 18: 21089
SUPERCONDUCTIVITY
development and uses, 18: 21096 (NP-13809)
of antiferromagnets, 18: 21103
of gallium phase formed at 35000 atm and 6.38°K, 18: 21108
surface, types I and II, 18: 21101
theories of, 18: 21106
theory of, excitations in, 18: 21107
SUPERCONDUCTORS
critical fields of niobium film, 18: 21114
critical temperature of anisotropic, theory of impurity effects on, 18: 21116
electronic thermal conductivity of, with strong electron-phonon coupling, 18: 21100
evaluation of β–titanium alloys as, 18: 21112
flux quantization in doubly connected, theory of, 18: 20667
magnetic fields of, effects of electron mean free path on, 18: 21109
magnetic flux trapping in ring of, 18: 21097 (UCRL-7308-T)
magnets of, design of, 18: 21118
properties in sixth-order-compensated solenoids, 18: 20298
properties of nonmagnetic, in vicinity of transition point, 18: 21105
thermoelectricity in intermediate state of, 18: 21099
transition temperature in thallium, impurity effects on, 18: 21113
transitions in strontium titanate, 18: 21102
tunneling current between two, separated by potential barrier, 18: 21111
SUPERFLUIDITY
sound velocity in helium-3 and -4 mixtures, fourth, 18: 21115
SUPERHEATERS (NUCLEAR)
power mapping of CSH-1 core, 18: 21698(R) (ANL-6860)
SUPERSONIC FLOW
over cone models, 18: 20119 (ARL-64-5)
plasma diagnostics of solid-propellant rocket exhaust plume containing cesium and potassium, 18: 21399
SURFACE WATERS
decontamination of Vistula River water by Warsaw filtration plant, 18: 20229 (CLOR-23)
fallout monitoring in Switzerland, 1956 to 1961, 18: 20218
radioactivity of, in Poland, 1958 through 1962, 18: 20211 (CLOR-24)
SWAGING
equipment for hydrostatic, 18: 20134(R) (ORNL-TM-792)
SWEDEN
fallout monitoring, 1959, 1962, and 1963, 18: 20212 (NP-13846)
SWIMMING POOL REACTORS
cooling system design, 18: 21688
fuel element arrangement in tank with variable pitch, device for, 18: 21690(P)
SWINE
calcium-45 and strontium-90 uptake by skeleton in miniature age effects on discrimination in, 18: 19539
SWITCHES
description of transistorized fail-safe high-low trip, 18: 20292
development of trigatrons for electric discharge equipment, 18: 20147
properties of trigatrons for initial control of spark gaps, 18: 20151
SWITZERLAND
fallout monitoring in air, fish, plants, soil, and waters, 1956 to 1961, 18: 20218
SYNCHROCYCLOTRONS
acceleration cycle in, optimization of, 18: 20685
SYNCHROTRONS
beam deflection structures in CERN, waveguide coupler matching for r-f, 18: 20679 (CERN-64-14)
bubble chamber experiments at CERN proton, 18: 20400
development and operation of CERN proton, 18: 20693
development in Western Europe, 18: 20697
development of high-energy proton, 18: 20696
experiments at CERN proton, use of spark chambers in, 18: 20401
proton source for, design of, 18: 20690
radiation effects on interior targets in, 18: 20687
use in study of malignant tissue proton response, 18: 19812 (BNL-6966)
use of CERN proton, for elementary particle studies, 18: 20965
SYSTEMS FOR NUCLEAR AUXILIARY POWER
component corrosion by mercury, 18: 21675 (NP-13795)
development of reactor-thermionic element combination, 18: 20837
kinetics equations for, computer program for solving, 18: 21669 (NAA-SR-9190)
reactor shielding requirements for, effects of minimum-weight radial reflector on, 18: 21670 (NAA-SR-Memo-9117)
shielding design for, 18: 21676 (SSD-TDR-63-217)
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-2)
coolant cross-flow distribution in, effects of "unfed" peripheral channels on, 18: 21673 (NAA-SR-Memo-9576)
flight instrumentation for, development of platinum resistance thermometer for, 18: 20283 (NAA-SR-Memo-8073)
tests of corrosion product separator in Haynes 25 Alloy loop containing mercury, 18: 21677 (TID-20552)
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-4)
coolant radiolytic decomposition in, hermetic sealing problems from, 18: 21672 (NAA-SR-Memo-9507)
core two-dimensional two-phase flow model and IBM 7090 code for, 18: 21557 (NAA-SR-Memo-9444)
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-8)
coolant flow in tri-cusp channel in, salt velocity technique for, 18: 21671 (NAA-SR-Memo-9232)
SYSTEMS FOR NUCLEAR AUXILIARY POWER (SNAP-10)
radiation effects on thermal control materials for, gamma, neutron, and uv, 18: 20603

T

TALOSE
oxidation by bromine, tritium isotope effects in, 18: 20031
TANDERIL
protective effects in rats against gamma radiation, 18: 19803
TANKS
optimization of two-stage chemical, 18: 20156
TANTALUM
analysis for hafnium and zirconium, 18: 19920
analysis for impurities by d-c arc method, spectrographic, 18: 19894
compatibility with thorium and uranium borides and carbides,

18: 20450(R) (BMI-1661(Del.))
diffusion in platinum, concentration gradients of, 18: 20512 (ASD-TDR-62-7(Pt.II))
diffusion of boron and carbon in, conditions for, 18: 20540
neutron cross sections for, nine-group, 18: 21170 (GEMP-279)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron scattering at 15.2 Mev, angular distributions in elastic, 18: 21340
oxidation by oxygen at 30 to 1100°C, 18: 20468(R) (AROD-2734:2)
radiation effects on mechanical properties of, review, 18: 20456 (ORNL-3593)
superconductivity of, surface, 18: 21101
welding of, development of methods for, 18: 20134(R) (ORNL-TM-792)

TANTALUM ALLOYS
mechanical properties of, review, 18: 20456 (ORNL-3593)
Hf–Ta–W, fabrication of T-111, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Nb–Ta, spectrographic analysis for hafnium, thorium, titanium, and zirconium simultaneously, 18: 19912
Nb–Ta–W–Zr, coating of FS-85, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, corrosion of platinum- and platinum–rhodium-clad FS-85, by air at 2200 and 2550°F, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, fabrication of FS-85, by forging, 18: 20484(R) (AD-418992)
Pt–Ta, phase studies, 18: 20512 (ASD-TDR-62-7(Pt.II))
Rh–Ta–Ti, superconductivity, 18: 21112

TANTALUM CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
free energy of formation at 1180 to 1370°K, 18: 19970
Co–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Co–NbC–TaC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–NbC–TaC–TiC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Mo–Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)

TANTALUM ELECTRODES
performance as collector in low-voltage arcs, 18: 20851
thermionic emission from cesium-coated, work function for, 18: 20864
thermionic emission from, work function for, 18: 20867

TANTALUM ISOTOPES Ta-182
energy levels of, rotational, 18: 21312

TANTALUM NITRIDES
emissivity measurements to 3000°K, equipment for, 18: 20567

TANTALUM OXIDES
performance as emitter in thermionic cells, 18: 20855
As_2O_5–Ta_2O_5, crystal structure of tetragonal phases in, 18: 19942
P_2O_5–Ta_2O_5, crystal structure of tetragonal phases in, 18: 19942
Ta_2O_5–V_2O_5, crystal structure of tetragonal phases in, 18: 19942

TANTALUM SILICIDES
magnetic susceptibility, 18: 20541

TECHNETIUM ISOTOPES Tc-99
energy levels and gamma spectra of, from Coulomb excitation, 18: 21350
production of carrier-free, by ion exchange and selective adsorption, 18: 20071
use as pertechnetate for organ scanning, 18: 19814 (CONF-453-1)

TECHNETIUM ISOTOPES Tc-103
beta decay energies, 18: 21319

TECHNETIUM ISOTOPES Tc-104
beta decay energies, 18: 21319

TECHNETIUM ISOTOPES Tc-105
beta decay energies, 18: 21319

TEETH
alpha-emitter content of human, 18: 19532
radiation effects on strontium-90 uptake by rat, x, 18: 19655

TELEMETERING SYSTEMS
design and operation for safety at Julich Nuclear Research Center, 18: 20257

TELLURIUM ISOTOPES Te-129
decay scheme of isomers of, 18: 21285

TEMPERATURE
effects of 2°C on radiosensitivity of *Drosophila melanogaster*, 18: 19707
effects on separation of rare earths by anion exchange in EDTA, 18: 20110
effects on serum protein in gamma-irradiated rats, 18: 19642
measurement of, development of capacitance sensors for, 18: 21564(R) (GEMP-81)
radiation effects on body, protective effects of oxytetracline against, 18: 19792

TEMPERATURE CONTROL
regulator design for, in liquid-hydrogen bubble chambers, 18: 20367

TENDONS
radiation effects on cow, effects of cysteine, drying, hydration, and tanning on electron, 18: 19629

TENNESSEE RIVER SYSTEM
radioisotopes in, biological, chemical, and physical effects of, 18: 21697

TERBIUM
compressibility at room temperature, 18: 20553
content and relative abundances in terrestrial materials, 18: 20202
separation by anion exchange in EDTA, effects of temperature on, 18: 20110

TERBIUM ISOTOPES Tb-151
energy levels, 18: 21348

TERBIUM ISOTOPES Tb-152
energy levels, 18: 21348

TERBIUM ISOTOPES Tb-153
decay and half life, 18: 21348

TERBIUM ISOTOPES Tb-154
decay and half life, 18: 21348

TERBIUM ISOTOPES Tb-155
energy levels, 18: 21176 (JINR-P-1479(p.35-9))

TERBIUM ISOTOPES Tb-160
energy levels of, rotational, 18: 21312

TERPHENYL
alpha and electron excitation of, pulse-height ratios for, 18: 20408
alpha excitation of, effects of thickness on rotation of light from, 18: 20409
spectra of solutions of, beta and uv excitation, 18: 20046

TETRACYCLINE
oxy-, protective effects of, against febrile reactions to gamma radiation, 18: 19792

TEXTILES
radioisotope uses in, 18: 20424

THALLIUM
effects on superconductivity of niobium–tin alloys, 18: 21110
neutron scattering at 300 to 1500 kev, 18: 21698(R) (ANL-6860)
performance as reactor coolant, evaluation of, 18: 20192
spectra of μ-mesic atom of, effects of shell structure on, 18: 21331
superconducting transition temperature in, impurity effects on, 18: 21113

THALLIUM ALLOYS
Tl–Sn, tin-119 Mössbauer effect in, 18: 20007

THALLIUM ISOTOPES Tl-203
gamma spectra, 18: 21317

THALLIUM ISOTOPES Tl-208
conversion electron spectra, 18: 21313

THAMES RIVER
strontium-90 content of, 18: 20208 (AERE-R-4415)

THERMAL CONDUCTIVITY
calculation of, for plasma, 18: 21397
measurement of, equipment and methods for, 18: 20539
theory for quantum systems, 18: 21070

THERMAL DIFFUSION
flow in columns for, equation of continuity for, 18: 21709(R) (MLM-1179)
measurement at 10 to 250°K, design of equipment for, 18: 21707(R) (MLM-1177)

THERMAL INSULATION
radiation effects on, in vacuum and at cryotemperatures, 18: 20581(R) (FZK-172)

THERMAL REACTORS
safety studies, 18: 21698(R) (ANL-6860)
THERMIONIC CELLS
cathode development for cesium-filled, 18: 20865
cathode emission behavior in, impurity effects on, 18: 20875
cathode heat balance in cesium filled, 18: 20868
cathode material compatibility with carbide fuel, 18: 20878
cathode materials compatibility with fission heat source, 18: 20874
cathode materials compatibility with fission heat source, 18: 20876
cathode nonuniform emission in cesium-filled, 18: 20862
cathode work functions in, effects of cesium coating on, 18: 20864
cathode work functions in arc mode, evaluation of, 18: 20867
cathodes for, development of barium–uranium, 18: 20877
cathodes for, evaluation of molybdenum, 18: 20872
cathodes in, development of uniform work function, 18: 20863
cesium ionization in, processes for volume, 18: 20850
cesium ionization and resonance absorption in, processes for, 18: 20853
cesium performance in power generation region of, 18: 20854
collector work functions in, emitter temperature dependence of, 18: 20869
collectors for, development and testing of low-work-function, 18: 20829(R) (AD-429503)
collectors for, development of, 18: 20870
conference on, 18: 20841
design and development of cesium-filled, 18: 20881
development for uses in space navigation, 18: 20837
development of cesium, 18: 20834(R) (NP-13808)
development of gasoline-fueled, 18: 20887
development of internal flame-heated, 18: 20886
development of low-temperature, 18: 20859
electric current-voltage curves for low-pressure, 18: 20843
electric current-voltage data for cesium-filled, 18: 20844
electric current-voltage characteristics in ignited mode, 18: 20849
electron emission in, parameter for S-curves of, 18: 20866
electron scattering in unignited mode of, 18: 20846
electron scattering in unignited mode of, 18: 20847
energy transfer in, correlations and measurements of, 18: 20852
fabrication and testing of cesium-vapor, with uranium carbide–zirconium carbide emitters, 18: 20832(R) (GA-4511)
gas analysis and dosing in, apparatus for, 18: 20856
materials compatibility with cesium in, 18: 20873
performance in ignited mode, characteristics of, 18: 20850
performance of auxiliary discharge, 18: 20858
performance of capillary, 18: 20857
performance of cesium filled, apparatus for determining impurity effects on, 18: 20856
performance of low-temperature cesium, 18: 21367(R) (AD-429133)
performance of parallel-plane, 18: 20855
performance of radioisotope-fueled, in series, 18: 20883
performance of radioisotope-fueled, in parallel or series connection, 18: 20885
performance of, computer program for evaluation of, 18: 20884
performance of, using inert gases, 18: 20831 (APL-TDR-64-28)
plasma oscillations in, 18: 20840
plasma parameters in low-voltage, 18: 20851
power generation from, pulsating d-c, 18: 20888
power output and work function of, effect of additives on, 18: 20871
radiation effects on performance of, neutron, 18: 20881
radiation effects on radioisotope-fueled, in-pile testing of, 18: 20882
radioinduced ionization in, fission-fragment, 18: 20860
radioinduced space-charge neutralization in inert gas-filled, 18: 20861
theory of, models for, 18: 20848
voltages of, ion drag of electrons for high open-circuit, 18: 20845
THERMOCOUPLES
calibration of Alumel-Chromel micro-, to 1800°F, 18: 20160(R) (AD-423679)
THERMODYNAMICS
of plasma, theory of, 18: 21450
quantum cell model for hard spheres in, 18: 21053
THERMOELECTRIC CELLS
development and testing, 18: 21698(R) (ANL-6860)
THERMOELECTRIC MATERIALS
phase transformations in gallium–plutonium alloys, power difference in, 18: 20527 (RFP-351)
THERMOMETERS
behavior of helium-gas, at temperatures below 77°K, static and dynamic, 18: 20286 (UCRL-7327)
development of helium-3 vapor-pressure, for 0.3 to 3.2°K, 18: 21708(R) (MLM-1178)
development of helium-3-filled, 18: 21709(R) (MLM-1179)
THERMOMETRY
inductive, methods in, 18: 20282 (HW-SA-3035)
THERMONUCLEAR EXPLOSIONS
transuranic element yields in debris from Anacostia event, 18: 20638 (UCRL-7347)
THERMONUCLEAR REACTIONS
temperature attainability by impact shock waves in deuterium–tritium systems from accelerated solid particles, 18: 21418
THERMONUCLEAR REACTORS
design, 18: 21542(P)
particle motion in Alpha, 18: 21436
THICKNESS GAGES
design of beta, for measuring coatings being applied to sheet, 18: 20323(P)
properties of radiometric, in industry, 18: 20425
use of beta absorption, to measure copper coatings on fiberglass, 18: 20277 (ADR-09-06b-62)
uses of radiometric, in highway engineering, 18: 20120
THIOCYANATE COMPLEXES
with rhenium, valency in, 18: 20004
with rhenium, valency in, 18: 20006
THIOPHENE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
THIOPHOSPHORIC ACID, ALKYL ESTERS
synthesis of phosphorus-32-labeled, 18: 20024
THORITES
alpha activity and thorium concentration in, in Conway granite, 18: 20222
THORIUM
analysis for rare earths using xylenol orange, spectrophotometric, 18: 19883
content in Conway granite, 18: 20222
determination in urine method for, 18: 19917
determination simultaneously, with hafnium, titanium, and zirconium in ores, spectrographic, 18: 19912
determination with rare earths in monazites, thorium phosphates, and xenotimes, 18: 19885
electrodeposition of films of, by molecular plating, 18: 20494
electron binding energies in, 18: 20767
neutron scattering at 15.2 Mev, angular distributions in elastic, 18: 21340
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
separation from rare earths and yttrium by solvent extraction using acetyl acetone, 18: 20106
separation from scandium by ion exchange in chloride–thiocyanate media, 18: 20113
separation from uranium by ion exchange in aqueous malonic acid, 18: 20114
shielding properties, 18: 21543 (BMI-1384)
stacking-fault energy, 18: 20550
THORIUM ALLOYS
Al–Mn–Th, phase studies of $ThAl_x$–$ThMn_2$, 18: 20554
Bi–Th, separation of uranium from solid intermetallic compounds of, 18: 20118(P)
Pb–Th, separation of uranium from solid intermetallic compounds of, 18: 20118(P)
THORIUM CARBIDES
free energy of formation at 700 to 970°C, standard molar, 18: 19977
THORIUM CHLORIDES
effects on blood coagulation, 18: 19535
THORIUM COMPLEXES
with 8-quinolinol, depolarimetry by potassium bromate, 18: 20106
THORIUM DEPOSITS (JAPAN)

seats of origin of, 18: 20226 (INSJ-67)
THORIUM ELECTRODES
Th–W, heat balance in thermionic cells, 18: 20868
THORIUM ISOTOPES Th-228
content in human bones and teeth, 18: 19532
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
THORIUM ISOTOPES Th-230
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
THORIUM ISOTOPES Th-232
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
neutron fission of, delayed gamma spectra from fast, 18: 21296
photofission at 20 Mev, delayed gammas from, 18: 21298
THORIUM ISOTOPES Th-234
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
THORIUM OXIDES
nuclear magnetic resonance of sorbed molecules on, temperature dependence of, 18: 20632 (TID-18689)
THORIUM(IV) OXIDES
density of hot-pressed pellets of, quadratic equation for predicting, 18: 20524 (ORNL-3608)
effects on blood coagulation, 18: 19535
radiation dose from injected, in man, 18: 20340(R) (TID-20525)
radiodiagnosis of spinal cord using, nervous system injuries from, 18: 19659
BeO–PuO_2–ThO_2, development for pebble-bed reactors, 18: 21658
BeO–ThO_2–UO_2, diffusion of xenon-133 in, 18: 20572
BeO–ThO_2–UO_2, fabrication of dispersions of, for optimum crystal structure, 18: 20498
BeO–ThO_2–UO_2, fabrication of dispersions of, by cosintering, 18: 20483 (AAEC/E-116)
BeO–ThO_2–UO_2, radiation damage due to fission products in, 18: 20615
ThO_2–UO_2, coating of particles of, with aluminum oxide and beryllium oxide, 18: 20570
ThO_2–UO_2, performance as fuel in 1000-Mw(e) SGR, hydraulic and thermal, 18: 21616 (NAA-SR-Memo-9569)
THORIUM PHOSPHATES
analysis for rare earths and thorium, 18: 19885
THORIUM SYSTEMS
B–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))
C–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))
THREONINE
uptake of labeled, by isolated intact rat diaphragm, effects of insulin on, 18: 19540
THRESHOLD DETECTORS
fabrication of plutonium by sealing in copper cans, 18: 21708(R) (MLM-1178)
THULIUM
content and relative abundances in terrestrial materials, 18: 20202
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
thulium-169 Mössbauer effect in, internal conversion coefficient for 8.42-kev, 18: 21290
THULIUM ALLOYS
Nd–Tm, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
THULIUM ISOTOPES Tm-164
decay of, gamma spectra at 500 to 3500 kev in, 18: 21174 (JINR-P-1479(p.3-25))
THULIUM ISOTOPES Tm-169
Mössbauer effect of 8.42-kev transition in, internal conversion coefficient from, 18: 21290
THULIUM OXIDES
thulium-169 Mössbauer effect in, internal conversion coefficient for 8.42-kev, 18: 21290
THYMIDINE
inactivation of bacteria and bacteriophage by tritium-labeled, 18: 19633
incorporation by DNA of tritiated, for tracer study of hematopoietic tissue transplantation, 18: 19527
uptake by hamster cells of tritium-labeled, effects on cell death, 18: 19645
uptake by HeLa cells of tritiated, 18: 19644
uptake of tritiated, to study effects of AET and cysteamine on DNA synthesis, 18: 19524
THYMUS
effects on immune reactivity and lymphoid regeneration in irradiated mice, 18: 19546
radiation chimeras in mice, effects of fetal thymus cell transplantation on x, 18: 19766
radiation effects on lymph cells in rat, 18: 19674
radiation effects on phosphonucleoside content of rat, 18: 19702
radioinduced tumors in mouse, fission neutron, 18: 19576
THYROID GLAND
iodine-131 effects on protein metabolism in calcified tissues of, 18: 19679
photoscanning of, after injection of technetium-99m as pertechnetate, 18: 19814 (CONF-453-1)
polonium-210 distribution in rat, 18: 19542
radioinduced tumors of, 18: 19598
TIN
magnetic field of hard superconducting, effects of electron mean free path on critical, 18: 21109
performance as reactor coolant, evaluation of, 18: 20192
physical properties of liquid, review, 18: 20516 (EUR-599.d)
radioinduced reactions with 1-bromobutane, 18: 20450(R) (BMI-1661 (Del.))
separation from fission products, radiochemical, 18: 19837(R) (MIT-905-1)
TIN ALLOYS
Au–Sn, tin-119 Mossbauer effect in, 18: 20007
Nb–Sn, superconductivity of, effects of substitution of other elements for part of tin on, 18: 21110
Pt–Sn, tin-119 Mössbauer effect in, 18: 20007
Sn–Ti, transformation characteristics during continuous cooling, 18: 20545
Sn–V–Zr, corrosion by steam at 350, 400, and 480°C, 18: 20476(T,R) (EURAEC-916)
Sn–V–Zr, mechanical properties at 20, 200, 500, and 700°C, 18: 20476(T,R) (EURAEC-916)
Tl–Sn, tin-119 Mössbauer effect in, 18: 20007
TIN COMPOUNDS
organic, stabilization reactions with polyvinyl chloride, 18: 20028
organic, stabilization reactions with polyvinyl chloride, 18: 20029
organic, stabilization reactions with polyvinylchloride, 18: 20030
TIN IONS
effects on isotopic exchange between iodine and *o*-iodoanisole, 18: 19964
spectral locations and widths in plasma, 18: 21409(T)
TIN ISOTOPES Sn-113
electron-capture decay of, L/K-capture ratio in, 18: 21267
TIN ISOTOPES Sn-118
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359
TIN ISOTOPES Sn-119
internal conversion coefficients for, 18: 21365
Mössbauer effect in tin alloys, 18: 20007
Mössbauer effect in, in β-tin polycrystals at 1.3 to 370°K, 18: 21157(R) (AFOSR-5284)
TIN OXIDES
sorptive properties for protactinium, 18: 20105
TISSUE CULTURES
radiation effects on human-cell, relative *y* and x, 18: 19685
radiation effects on reproduction of smallpox virus in, 18: 19687
TISSUES
homografts of mouse skin, effects of bacterial infection on, 18: 19511
oxidation-reduction in, 18: 19680
radiation effects on regeneration of trauma of, in salamanders and mice, 18: 19553(R) (TID-20513)
radiation effects on apple tree, gamma, 18: 19567
radiation effects on homografts of skin, from bismuth-206 and silver-111,

18: 19605
radiation effects combined with antibiotics on fish homografts of scale, x, 18: 19726
radiation effects on rat submucosal, protective effects of Tanderil (oxyphenylbutazone) against, gamma, 18: 19803
radiation injuries and repair in normal and neoplastic, 18: 19802
radiation response of mammalian, proton, 18: 19812 (BNL-6966)
radiosensitivity of, index for, 18: 19680

TITANIUM
analysis for oxygen, activation, 18: 19886
analysis for oxygen, comparison of activation and vacuum fusion methods, 18: 19922
corrosion by mercury, 18: 21698(R) (ANL-6860)
corrosion-resistant film production on, in aqueous chlorides and sea water, 18: 20481
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in molybdenum, tungsten, and their alloys, classical methods for, 18: 19921
determination in silicate rocks, quantometric and spectrographic, 18: 19910
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
determination simultaneously with hafnium, thorium, and zirconium in ores, spectrographic, 18: 19912
diffusion of boron and carbon in, conditions for, 18: 20540
effects on spalling of niobium at high temperatures, 18: 20474 (TID-12794)
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104

TITANIUM ALLOYS
Al–Cr–Ni–Ti, corrosion of Inconel 702 by superheated steam, 18: 21668(R) (GEMP-274)
Al–Ti, transformation characteristics during continuous cooling, 18: 20545
Au–Rh–Ti, superconductivity, 18: 21112
Co–Rh–Ti, superconductivity, 18: 21112
Cr–Rh–Ti, superconductivity, 18: 21112
Cu–Rh–Ti, superconductivity, 18: 21112
Fe–Rh–Ti, superconductivity, 18: 21112
Hf–Rh–Ti, superconductivity, 18: 21112
Ir–Rh–Ti, superconductivity, 18: 21112
Mn–Rh–Ti, superconductivity, 18: 21112
Mo–Rh–Ti, superconductivity, 18: 21112
Mo–Ti, emissivity measurements at 800 to 5000°K, 18: 20566
Mo–Ti, transformation characteristics during continuous cooling, 18: 20545
Mo–Ti–Zr, coating of TZM, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Mo–Ti–Zr, corrosion of platinum- and platinum–rhodium-clad TZM, by air at 2550°F, 18: 20445(R) (AD-434441)
Nb–Rh–Ti, superconductivity, 18: 21112
Nb–Ti, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Nb–Ti, transformation characteristics during continuous cooling, 18: 20545
Ni–Rh–Ti, superconductivity, 18: 21112
Os–Rh–Ti, superconductivity, 18: 21112
Pd–Rh–Ti, superconductivity, 18: 21112
Pt–Rh–Ti, superconductivity, 18: 21112
Re–Rh–Ti, superconductivity, 18: 21112
Rh–Ag–Ti, superconductivity, 18: 21112
Rh–Ru–Ti, superconductivity, 18: 21112
Rh–Sc–Ti, superconductivity, 18: 21112
Rh–Ta–Ti, superconductivity, 18: 21112
Rh–Ti, superconductivity, 18: 21112
Rh–Ti–V, superconductivity, 18: 21112
Rh–Ti–W, superconductivity, 18: 21112
Rh–Ti–Y, superconductivity, 18: 21112
Rh–Ti–Zr, superconductivity, 18: 21112
Sn–Ti, transformation characteristics during continuous cooling, 18: 20545
Ti–V, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Ti–V, transformation characteristics during continuous cooling, 18: 20545

TITANIUM BORIDES
emissivity measurements to 3000°K, equipment for, 18: 20567

TITANIUM CARBIDES
atomic vibration amplitudes, 18: 19987
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
thermal expansion, 18: 19987
Co–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Co–NbC–TaC–TiC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Mo–Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)
Ni–NbC–TaC–TiC, thermal expansion at 68 to 1800°F, 18: 20513 (CNLM-4234)

TITANIUM NITRIDES
atomic vibration amplitudes, 18: 19987
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
thermal expansion, 18: 19987

TITANIUM OXIDES
formation of corrosion resistant films of, in aqueous chloride and sea water, 18: 20481

TITANIUM SILICIDES
magnetic susceptibility, 18: 20541

TITANIUM SYSTEMS
C–Mo–Ti–Zr, dispersed phase studies in Mo-TZC, 18: 20512 (ASD-TDR-62-7(Pt.II))
Cr–Si–Ti, properties as coating for B-66 and D-43 alloys, 18: 20523(R) (NP-13811)

TOBACCO
radiation effects on plants and seed of, 18: 19690

TOCOPHEROLS
protective effects in mice against radiation, 18: 19797
protective effects against radiation injuries in mice, 18: 19797

TOLUENE
effects on radiolysis of polyisobutene at 4 Mev, 18: 20066
radiation effects on deuterated, gamma, 18: 20053
radiolysis of, relation of linear energy transfer and yields in, 18: 20055
radiolysis of, yield of free radicals in, 18: 20042 (USNRDL-TR-718)
benzene–toluene, radiation effects on normal and deuterated, 18: 20054

TOLUENESULFONIC ACID, ALKYL ESTERS
reaction rates of, spectrophotometric analysis of, 18: 19837(R) (MIT-905-1)

TOMATOES
ion movement into root xylem of, effects of water movement on, 18: 21723 (TID-18877)

TOWER SHIELDING FACILITY
reactor position indicator, 18: 20134(R) (ORNL-TM-792)
slack cable protection system for, 18: 20134(R) (ORNL-TM-792)

TOXICITY
of chemical agents to cytoplasm, effects on antibody production, 18: 19523
of ozone to animals, 18: 19538

TRACER TECHNIQUES (AGRICULTURE)
bibliography on, 18: 20423

TRACER TECHNIQUES (BIOLOGY)
bibliography on, 18: 20423
for hematological studies, 18: 19504 (BNL-7839)
for study of dynamics of metabolic processes in open biological systems, 18: 19537
review and introductory text, 18: 19514

TRACER TECHNIQUES (CHEMICAL ENGINEERING)
preparation of short-lived radioisotopes for injection into petroleum hydrocarbons, 18: 20427(P)

TRACER TECHNIQUES (ENGINEERING)
use in highway construction, 18: 20120
wear measurement by scintillation technique, radiometric method for, 18: 20426

TRACER TECHNIQUES (MEDICINE)
for liver scanning with molybdenum-99, 18: 19834

use of labeled colloidal albumin aggregates for organ scanning, 18: 19813 (CONF-164-11)
use of technetium-99m for organ scanning, 18: 19814 (CONF-453-1)
TRANSDUCERS
radiation effects on ultrasonic, 18: 20457(R) (SWRI-1228-19)
TRANSISTORS
radiation effects on, transient, 18: 20321
use of field-effect, in nuclear instrumentation, 18: 20279 (BNL-7867)
TRANSPLUTONIC ELEMENTS
separation of, alpha and neutron counters for column, 18: 20101 (UCRL-11300)
TRANSURANIC ELEMENTS
yields in debris from Anacostia underground thermonuclear explosion, 18: 20638 (UCRL-7347)
TRAUMA
radiation effects on tissue regeneration after, in salamanders and mice, 18: 19553(R) (TID-20513)
TREES
radiation effects on chimeras of apple, gamma, 18: 19567
radiation effects on grafts in cherry, 18: 19691
TRIMESIC ACID
analytical uses for gravimetric determination of hafnium and zirconium, 18: 19871
TRIOXANES
polymerization in solid state by boron trifluoride in n-hexane, 18: 20032
TRITIUM
binding energy in $_{\Lambda}H^{3}$ for nonlocal interaction, 18: 21182 (JINR-P-1579)
determination by beta counting, development of scintillation detector for, 18: 19887
determination by liquid scintillation coincidence circuit, 18: 19890
determination in carbon-14 mixture by liquid scintillation counting, statistics of, 18: 19872
determination in gases by counting, design of vacuum system for, 18: 21707(R) (MLM-1177)
determination in mixtures with carbon-14 or phosphorus-32, conditions for two-channel liquid scintillation, 18: 19873
deuteron reactions (d,n) at 3 to 19 Mev, cross sections for, 18: 21218
diffusion from irradiated beryllium oxide at 300 to 1650°C, 18: 20612
diffusion from irradiated beryllium oxide powders, 18: 20613
effects on cell death of hamster cells from uptake of labeled thymidine or uridine, 18: 19645
effects on oxidation of aldoses by bromine, 18: 20031
electric and magnetic form factors, 18: 21326
energy dissipation in bacteria and bacteriophage, 18: 19633
incorporation in myoinositol by Wilzbach method, position of, 18: 20073
introduction into palmitaldehyde, 18: 20025
preparation by irradiation of lithium-6 alloys, 18: 20431
proton reactions (p,n) with, 18: 21217
proton reactions (p,n) with, threshold energy for, 18: 21284
sorption by foamed poly(vinyl chloride), 18: 20458 (USNRDL-TR-717)
stability in, labeled 1,2-D-aldosterone, 18: 19543
uptake by DNA, from labeled thymidine, for tracer study of hematopoietic tissue transplantation, 18: 19527
uptake by HeLa cells from labeled thymidine and uridine, 18: 19644
uptake by *Vicia faba* root meristem cells from labeled arginine, 18: 19518 (BNL-7007)
TRITIUM SYSTEMS
D–T, shock waves from impact of accelerated solid particles in, attainability of fusion temperatures in, 18: 21418
TRITONS
angular distribution-spin dependence in (d,t) reactions, 18: 21301
attenuation by silicon semiconductor detectors, 18: 20376
diffusion in ice crystals at 0 to –35°C, 18: 20963
form factors, 18: 21019
production of, equipment for pulsed, 18: 20654
reactions (t,α), (t,d), (t,p), and (t,t) with nitrogen-14 at 1 to 2 Mev, differential cross sections for, 18: 21282
reactions (t,p) with fluorine-19, fluorine-21 energy levels from, 18: 21255
TROPOSPHERE
radioactivity in, artificial, 18: 21082
TRYPTOPHAN
photochemical reduction to tryptamine in aqueous solutions, 18: 20081
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
TUBERCULOSIS
radiation effects on, in guinea pigs, 18: 19715
TUBES
fabrication and properties of Zircaloy-4, with spacing projections, 18: 20450(R) (BMI-1661(Del.))
flow of steam–water mixtures in vertical, pressure drops in, 18: 20164 (EURAEC-1004)
hydride phase estimation in Zircaloy-2 process, metallographic, 18: 20518 (HW-74949)
radiation effects on tensile properties of type 347 stainless steel pressure, fast neutron, 18: 20450(R) (BMI-1661(Del.))
tensile properties of annealed and cold-worked stainless steel, at 20°C, 18: 21706(R) (KR-66)
TUMORS
cell generative cycle in, 18: 21701 (BNL-7925)
chemotherapy for malignant, protective effects of autologous bone marrow transfusions following, 18: 19768
incidence of, in populations of Hiroshima and Nagasaki, 18: 19596
localization of, by photoscanning after injection of labeled serum albumin colloids, 18: 19813 (CONF-164-11)
localization of, by radiation scanning after injection of radioisotopes, data recording system evaluation for, 18: 19835
radiation effects on mammalian, 18: 19572
radiation effects on transplantability of cells of, x, 18: 19651
radiation effects on grafting site of unirradiated, x, 18: 19695
radiation effects on mitosis in epidermal hyperplasia in mice, 18: 19704
radiation effects on, proton, 18: 19812 (BNL-6966)
radiation effects on, model for neutron, 18: 19816
radiodiagnosis of eye, 18: 19823
radioinduced in hamsters, x, 18: 19672
radioinduced in man, 18: 19597
radioinduced in mice, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and bone marrow against, x, 18: 19796
radioinduced thymic lymphoma, in mice, fission neutron, 18: 19576
radioinduced thyroid, 18: 19598
radioinduced, reaction mechanisms of, 18: 19595
radioprotective compound effects on, mouse, 18: 19774
radiosensitivity, 18: 19606
radiotherapy of uterine, devices for, 18: 19830
radiotherapy of, dosage determinations for, 18: 19828
radiotherapy of, protective effects of phospholipids against liver function disturbances in, 18: 19720
reaction mechanisms of induction of, 18: 19505 (BNL-7912)
repair of radiation injuries in, 18: 19802
ultrastructure of mouse mastacytoma, 18: 21732(T) (ANL-Trans-7)
TUNGSTEN
analysis for copper, iron, nickel, titanium, and zirconium, classical methods for, 18: 19921
atomic vibration amplitudes, 18: 19987
compatibility with thorium and uranium borides and carbides, 18: 20450(R) (BMI-1661(Del.))
compatibility with uranium dioxide, 18: 20450(R) (BMI-1661(Del.))
compatibility with uranium nitride, 18: 20450(R) (BMI-1661(Del.))
determination in tantalum by d-c arc method, spectrographic, 18: 19894
diffusion of boron and carbon in, conditions for, 18: 20540
diffusion of rhenium tracer in single-crystal, at 2660 to 3230°C, 18: 21335
effects on spalling of niobium at high temperatures, 18: 20474 (TID-12794)
electron ejection from, by helium, hydrogen, nitrogen, and oxygen ions, energy distributions and yields in, 18: 20777
fabrication and properties of, effects of alumina, potassium oxide, and silica on, 18: 20443(R) (AD-416199)
fabrication and properties of extruded and forged, 18: 20447(R) (ASD-TR-7-797(IX))
hydrogen ion reactions at 260 kev, uv radiation emission in, 18: 20781
neutron cross sections of, nine- and sixteen-group, 18: 21168 (GEMP-223)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)

oxidation by oxygen at 30 to 1100°C, 18: 20468(R) (AROD-2734:2)
performance as ion emitter for electrostatic thrustor, hot-wire calorimeter study of, 18: 20289
performance compatibility with fission heat source in thermionic cells, 18: 20876
proton reactions at 260 kev, uv radiation emission in, 18: 20781
radiation effects on mechanical properties of, review, 18: 20456 (ORNL-3593)
self-diffusion in single-crystal, at 2660 to 3230°C, 18: 21335
sputtering by xenon at 25 to 60 kev, energy dependence of, 18: 20785
thermal expansion, 18: 19987

TUNGSTEN ALLOYS
analysis for copper, iron, nickel, titanium, and zirconium, classical methods for, 18: 19921
mechanical properties of, review, 18: 20456 (ORNL-3593)
Hf–Ta–W, fabrication of T-111, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Mo–Nb–W, fabrication of, effects on mechanical properties, 18: 20485 (ASD-TDR-62-670(Pt.II))
Mo–W, fabrication and properties of extruded and forged, 18: 20447(R) (ASD-TR-7-797(IX))
Mo–W, performance compatibility with thermionic cell fission heat source, 18: 20874
Nb–Ta–W–Zr, coating of FS-85, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, corrosion of platinum- and platinum–rhodium-clad FS-85, by air at 2200 and 2550°F, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, fabrication of FS-85, by forging, 18: 20484(R) (AD-418992)
Nb–W, fabrication of, effects on mechanical properties, 18: 20485 (ASD-TDR-62-670(Pt.II))
Nb–W–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated D-43, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Re–W, analysis for rhenium, spectrographic, 18: 19881
Rh–Ti–W, superconductivity, 18: 21112

TUNGSTEN CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
thermionic emission behavior of, 18: 20875
Co–Nbc–TaC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–NbC–TaC–TiC–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)
Co–WC, thermal expansion at 68 to 1800°F, 18: 20514 (CNLM-4479)

TUNGSTEN ELECTRODES
cesium ion and electron emission by, relation to diode diagnostics, 18: 20842
ion emission by, secondary, 18: 20136
performance in thermionic cells, current-voltage data for, 18: 20844
thermionic emission in cesium-filled diodes, nonuniform, 18: 20862
thermionic emission from, work function for, 18: 20863
thermionic emission behavior of, effects of carbon on, 18: 20875
Re–W, thermionic work function for, 18: 20867
Th–W, heat balance in thermionic cells, 18: 20868

TUNGSTEN ISOTOPES W-180
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)

TUNGSTEN ISOTOPES W-182
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)

TUNGSTEN ISOTOPES W-184
deuteron reactions (d,p) with, total cross sections for, 18: 21335
deuteron reactions (d,2n) with, total cross sections for, 18: 21335
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)

TUNGSTEN ISOTOPES W-185
half life, 18: 21335

TUNGSTEN ISOTOPES W-186
deuteron reactions (d,p) with, total cross sections for, 18: 21335

TUNGSTEN ISOTOPES W-187
half life, 18: 21335

TUNGSTEN OXIDES
crystal structure of $Nb_2O_5 \cdot 3WO_3$, 18: 19941
preparation, properties, and analytical uses of WO_3, 18: 19879

TUNGSTEN SYSTEMS
$BaO–UO_3–W$, development as thermionic emitters, 18: 20877
LiH–W, shielding properties, 18: 21676 (SSD-TDR-63-217)
$W–UO_2$, thermal expansion coefficient during one thermal cycle, linear, 18: 20450(R) (BNI-1661(Del.))

TURBINE NOZZLES
design, 18: 21675 (NP-13795)

TURBINES
bearing design and performance in high-speed gas-lubricated, 18: 20135(R) (TID-20448)
performance with gas-lubricated bearings, 18: 21095(R) (NBS-8239)

TURTLES
radioactivity of, effects of environment on, 18: 19517

TYRAMINE
preparation by photochemical reduction of tyrosine, 18: 20081

TYROSINE
photochemical reduction to tyramine in aqueous solutions, 18: 20081

U

ULCERS
radioinduced in radiotherapy of carcinomas of skin or lips, 18: 19714

ULTRASONICS
cavitation induction in liquid helium by, at 1.2 to 2.3°K, 18: 20678
human response to, 18: 21704 (HW-SA-3028)
technique for measuring elastic moduli at high temperatures, 18: 20196 (UCRL-7326)

ULTRAVIOLET RADIATION
chemical effects on alkali nitrate solutions, 18: 20080
chemical effects on amino acids, 18: 20081
detection and measurement in chromatographic eluants, continuous flow analyzer for, 18: 19870
effects on bacteriophage T1, effects of freeze-drying, low temperature, and sulfhydril compounds on, 18: 19634
effects on chymotrypsin kinetics, 18: 19666
effects on hatching and pathogenicity of *M. kapla* eggs, 18: 19759
effects on mutation frequencies in Aspergillus, environmental modification of, 18: 19724
effects on reticulocytes in peripheral blood of patients with dematologic diseases, 18: 19712
effects on rocket reactor thermal control materials, 18: 20603
effects on vaccinia virus, induction of Shay leukemia development in rats by, 18: 19614
emission in hydrogen ion and proton reactions with metals at 260 kev, 18: 20781
excitation of organic solutions by, 18: 20046
genetic effects on *Bacillus subtilis*, 18: 19753
mutagenic effects of, in microorganisms, 18: 19650
mutagenic effects in Neurospora, 18: 19621
pathological effects of, on rabbit eyes, 18: 19547(R) (AMRL-TDR-63-71)

UNDERGROUND EXPLOSIONS
crater formation by high-explosive sources in desert alluvium, calculation, 18: 20123 (UCRL-7738)
effects of Hardhat event on electrical potential of ground, 18: 20200 (ARA-1054)
engineering uses for highway excavation, 18: 20120
geologic factors in cavity and chimney formation in, in alluvium, granite, rock salt, and tuff, 18: 20122 (UCRL-7711)
isotope production and recovery from, in salt, 18: 20121 (CONF-470-1)
production of heavy isotopes by, 18: 20126 (UCRL-7770)
seismic data from Coast and Geodetic Survey in nuclear detonation series, 1961 to 1963, 18: 20201 (NP-13867)
seismic effects on structures, 18: 20127 (UCRL-7773)
shock waves in granite from Hardhat event, calculation, 18: 20125 (UCRL-7762)
transuranic element yields in debris from Anacostia event, 18: 20638 (UCRL-7347)

UNITED STATES
calcium content of soil samples from, 18: 19515 (NP-13796)
strontium-90 content in diet, 1953 through 1961, 18: 20235 (NP-13868)

URACIL, 5-BROMO-
effects on radiosensitivity of bacteriophage T1, 18: 19634

URACIL, 6-PROPYL-2-THIO-
protective effects against radiation in rats, 18: 19780
URANATES
preparation by pyrolysis of uranyl nitrate and metal nitrate mixtures, 18: 20012
URANIUM
bonding to aluminum jackets, inductive thermometry measurement of, 18: 20282 (HW-SA-3035)
cancer mortality attributable to milling and mining of, 18: 20256
carcinogenic effects of, in man, 18: 19597
content in urine of miners, 18: 20271
determination in cadmium solutions by chemical stripping, 18: 19851(R) (TID-20548)
determination in plutonium by controlled-potential coulometry and spectrophotometry, 18: 21707(R) (MLM-1177)
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination using 1-(2-pyridylazo-)-2-naphthol, spectrophotometric, 18: 19900
dissolution of, electrolytic, 18: 20115
electrodeposition of films of, by molecular plating, 18: 20494
neutron scattering at 15.2 Mev, angular distributions in elastic, 18: 21340
neutron total cross sections, 18: 21203 (LA-1493)
oxidation state in aqueous media, determination of, 18: 19896
polonium-210 content in urine of miners of, 18: 19916
preparation for use as alpha and beta sources, electrolytic, 18: 20422
production by electrolysis of dioxide in fluoride melt, 18: 20448 (BMI-6436)
proton reactions (p,n) at 6 Bev, 18: 21698(R) (ANL-6860)
reactions with graphite at 800 to 1100°C, 18: 19984
regulatory control program for milling, USAEC, 18: 20272
separation from aqueous media by solvent extraction using lanthanum fluoride and TTA, 18: 19896
separation from plutonium by ion exchange and solvent extraction, 18: 21707(R) (MLM-1177)
separation from rare earths and thorium by ion exchange in aqueous malonic acid, 18: 20114
separation from reactor fuels by fluid-bed chlorination and fluorination, 18: 21698(R) (ANL-6860)
separation from solid bismuth–thorium and lead–thorium intermetallic compounds, 18: 20118(P)
tensile and yield strengths of, effects of explosive impacting on, 18: 20535 (Y-1455)
URANIUM ALLOYS
analysis for constituents, photometric, 18: 19845 (JAERI-1053)
Mo–U, analysis for molybdenum, gravimetric, 18: 19846 (LA-3058)
U–Zr, fabrication and mechanical properties, 18: 20449 (BMI-973(Del.))
URANIUM CARBIDES
analysis for combined and free carbon, 18: 19902
burnup calculations for SRE core III, 18: 20455 (NAA-SR-Memo-9406)
carbon migration induced by thermal gradient in, 18: 20450(R) (BMI-1661(Del.))
coating of particles of, 18: 20450(R) (BMI-1661(Del.))
fission gas release from irradiated, effects of irradiation temperature on, 18: 20450(R) (BMI-1661(Del.))
performance compatibility with thermionic emitter materials, 18: 20878
performance of refractory-metal coated, as thermionic emitters, 18: 20874
preparation, 18: 21698(R) (ANL-6860)
preparation and properties of sintered pellets of, 18: 20493
preparation of sinterable powder of pure mono-, 18: 20467(P)
radiation effects on, of pyrolytic-carbon-coated particulate, at high burnup, 18: 21619
reactions with graphite, stabilization by uranium nitride, 18: 19923 (AERE-M-1360)
testing, 18: 21698(R) (ANL-6860)
PuC–UC, preparation, 18: 21698(R) (ANL-6860)
PuC–UC, production for use as fast reactor fuel, 18: 20507(P)
PuC–UC, production for use as fast reactor fuel, 18: 20508(P)
PuC–UC, thermal expansion coefficient at temperatures up to 900°C, linear, 18: 20522 (LADC-5788)
SiC–UC, performance in gas-cooled reactors, 18: 21659
UC–UN, decomposition to uranium and nitrogen, 18: 19923 (AERE-M-1360)
UC–UN, nitridation, 18: 19923 (AERE-M-1360)
URANIUM CHLORIDES
effects on blood coagulation, 18: 19535
URANIUM(IV) CHLORIDES
spectra in hydrochloric acid and organic solutions, absorption, 18: 19935 (TID-18814)
URANIUM COMPLEXES
with thiomalic acid, free energy of formation and spectra of, 18: 19947
URANIUM DEPOSITS (JAPAN)
seats of origin of, 18: 20226 (INSJ-67)
URANIUM DEPOSITS (UTAH)
mineralogical changes in sediments of geology of, 18: 20228
URANIUM(IV) FLUORIDES
BeF_2–LiF–UF_4–ZrF_4, analysis for chromium by amperiometric titration, 18: 19869
URANIUM(VI) FLUORIDES
corrosive effects on metals and alloys up to 1000°C, 18: 20469 (CEA-2385)
URANIUM ISOTOPES U-230
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
URANIUM ISOTOPES U-232
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
URANIUM ISOTOPES U-233
neutron fission of, neutron distributions from, 18: 21197 (KR-64 (Sect.XVIII))
neutron fission of, delayed gamma spectra from fast, 18: 21296
neutron fission resonance integral, 18: 21166 (CRRP-1183)
URANIUM ISOTOPES U-234
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
ratio to uranium-238 in Conway granite, 18: 20222
URANIUM ISOTOPES U-235
fission damage in calcites by, 18: 20224
fission of, relative yields of long-lived radioisotopes from, 18: 19516
fission products of, mass spectrographic separation of, 18: 20312
fission products of, distribution of near-symmetric, 18: 19837(R) (MIT-905-1)
fission-product energy and mass as a function of prompt fission gamma-ray energy, 18: 21343
neutron effective cross sections, 18: 21167 (CRRP-1191)
neutron fission at 2.5 and 14 Mev, probability of ternary, 18: 21219
neutron fission of, mass distributions from thermal, 18: 20358
neutron fission of, prompt neutron distributions from thermal, 18: 21198 (KR-64(Sect.XIX))
neutron fission of, fragment mass distribution for binary and ternary thermal, 18: 21280
neutron fission of, delayed gamma spectra from fast, 18: 21296
neutron fission of, beta decay and delayed gammas following, 18: 21297
neutron fission resonance integral, 18: 21166 (CRRP-1183)
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron total cross sections, 18: 21203 (LA-1493)
photofission at 20 Mev, delayed gammas from, 18: 21298
URANIUM ISOTOPES U-236
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
URANIUM ISOTOPES U-238
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
energy levels of, two-quasiparticle, 18: 21178 (JINR-P-1568)
fission damage in calcites by, 18: 20224
fission of, relative yields of long-lived radioisotopes from, 18: 19516
neon-22 reactions with, production of nobeliufn-256 in, 18: 21183 (JINR-P-1580)
neutron Doppler coefficient of, calculation of, 18: 21593 (APDA-157)
neutron fission at 2.5 and 14 Mev, probability of ternary, 18: 21219
neutron fission of, mass-energy relations in, 18: 21698(R) (ANL-6860)
neutron fission of, delayed gamma spectra from fast, 18: 21296
neutron reactions (n,α) with, instrument for detection of alpha particles from, 18: 20403
neutron reactions with, gamma production in, 18: 21169 (GEMP-278)
neutron resonances, 18: 21156 (AEEW-R-351)

photofission at 20 Mev, delayed gammas from, 18: 21298
ratio to uranium-234 in Conway granite, 18: 20222
URANIUM ISOTOPES U-240
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
URANIUM NITRIDES
compatibility with molybdenum and tungsten, 18: 20450(R) (BMI-1661 (Del.))
stabilization of graphite–uranium carbide reactions by, 18: 19923 (AERE-M-1360)
Fe–UN, composition of cermet of, for use as reactor fuel, 18: 20465(P)
UC–UN, decomposition to uranium and nitrogen, 18: 19923 (AERE-M-1360)
UC–UN, nitridation, 18: 19923 (AERE-M-1360)
URANIUM ORES
separation of radium-223 from, radiochemical, 18: 19840 (CEA-R-2419)
URANIUM OXIDES (STAINLESS STEEL CLAD)
development and testing for boiling reactors, 18: 21635(R) (GEAP-4481)
URANIUM OXIDES (Zr ALLOY CLAD)
development and testing for boiling reactors, 18: 21635(R) (GEAP-4481)
URANIUM(IV) OXIDES
coating of particles of, 18: 20450(R) (BMI-1661(Del.))
coating of particles of, with aluminum oxide and beryllium oxide, 18: 20570
compatibility with rhenium and tungsten, 18: 20450(R) (BMI-1661(Del.))
electrolysis in fluoride melt for production of uranium metal, 18: 20448 (BM-RI-6436)
fabrication into pellets for irradiation, 18: 20450(R) (BMI-1661(Del.))
hardness at −180 to 800°C, effects of annealing on, 18: 20544
neutron flux fine structure in clusters of, 18: 21612 (CEA-2387)
oxidation of, effects of sodium halides on, 18: 19943
performance compatibility with thermionic emitter materials, 18: 20876
performance of refractory metal coated, as thermionic emitters, 18: 20874
preparation and properties of ammonia-precipitated and sintered, 18: 21706(R) (KR-66)
processing of, oxidative decladding in mechanical, 18: 20111
production of granular, by arc melting, 18: 20509(P)
properties as reactor fuel, 18: 21643(R) (WAPD-MRP-107)
properties of molten, as reactor fuel, 18: 21620
sintering of pellets of, comparison of hydrogen and steam, 18: 20489
thermal properties, 18: 20459(T,R) (EURAEC-954)
BaO–UO_2–W, development as thermionic emitters, 18: 20877
Be–BeO–UO_2, fabrication and properties of sintered pellets of, 18: 20504
BeO–ThO_2–UO_2, diffusion of xenon-133 in, 18: 20572
BeO–ThO_2–UO_2, fabrication of dispersions of, for optimum crystal structure, 18: 20498
BeO–ThO_2–UO_2, fabrication of dispersions of, by cosintering, 18: 20483 (AAEC/E-116)
BeO–ThO_2–UO_2, radiation damage due to fission products in, 18: 20615
BeO–UO_2, fabrication by cold extrusion, 18: 20497
BeO–UO_2, fabrication into pellets for irradiation, 18: 20450(R) (BMI-1661(Del.))
BeO–UO_2, performance in gas-cooled reactors, 18: 21659
BeO–UO_2, properties as rocket reactor fuel, testing of, 18: 21698(R) (ANL-6860)
CaO–UO_2–ZrO_2, fabrication and properties as reactor fuel, 18: 21643(R) (WAPD-MRP-107)
CeO_2–UO_2, radiation effects on, 18: 20450(R) (BMI-1661(Del.))
PuO_2–UO_2, development and fabrication for reactor fuel elements, 18: 20460(T,R) (EURAEC-965)
PuO_2–UO_2, fabrication and testing, 18: 20459(T,R) (EURAEC-954)
PuO_2–UO_2, radiation effects on, 18: 20459(T,R) (EURAEC-954)
PuO_2–UO_2, reactivity of fuel elements of, 18: 21613 (HW-79960)
PuO_2–UO_2, thermal properties, 18: 20459(T,R) (EURAEC-954)
stainless steel–UO_2, electrolytic dissolution of, 18: 20115
ThO_2–UO_2, coating of particles of, with aluminum oxide and beryllium oxide, 18: 20570
ThO_2–UO_2, performance as fuel in 1000-Mw(e) SGR, hydraulic and thermal, 18: 21616 (NAA-SR-Memo-9569)
UO_2–ZrO_2, fabrication into pellets for irradiation, 18: 20450(R) (BMI-1661(Del.))
UO_2–ZrO_2, radiation effects on, 18: 20450(R) (BMI-1661(Del.))
W–UO_2, thermal expansion coefficient during one thermal cycle, linear, 18: 20450(R) (BMI-1661(Del.))
URANIUM PHOSPHIDES
UP–US, volatilization, 18: 21698(R) (ANL-6860)
URANIUM SULFIDES
sintering, 18: 21698(R) (ANL-6860)
UP–US, volatilization, 18: 21698(R) (ANL-6860)
URANIUM SYSTEMS
B–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))
C–Th–U, compatibility with metals and alloys, 18: 20450(R) (BMI-1661(Del.))
U–D_2O, critical level in, pulsed-neutron determination of, 18: 21595 (CEA-R-2376)
U–D_2O, physics calculations for organic cooled lattices of, 18: 21596 (EUR-597.e)
U–H_2O, neutron physics measurements, 18: 21594 (BNL-6975)
U–Zr–ZrH_2, properties as rocket reactor fuel, testing of, 18: 21698(R) (ANL-6860)
URANYL NITRATES
effects on blood coagulation, 18: 19535
effects on separation of nitric acid from aqueous solutions by solvent extraction using long-chain amines, 18: 20107
URANYL SULFATES
$CuSO_4$–H_2SO_4–UO_2SO_4, corrosive effects on stainless steel, 18: 20477
UREA
effects on chymotrypsin kinetics, 18: 19666
radiolysis of, formation of carbon-14-labeled compounds in neutron, 18: 20092
UREA, THIO-
protective effects on polyvinylpyrrolidone against gamma irradiation, 18: 20056
URIDINE
uptake by hamster cells of tritium-labeled, effects on cell death, 18: 19645
uptake by HeLa cells of tritiated, 18: 19644
URIDINE, 5-BROMO-2'-DEOXY-
effects on radiosensitivity of bacteriophage T1, 18: 19634
URINE
analysis for fission products from fallout in Japan, 1962 and 1963, 18: 20232 (JAERI-1057)
analysis for promethium-147 by liquid scintillation counting, 18: 19875
analysis for thorium, method for, 18: 19917
polonium-210 content in, of uranium miners, 18: 19916
radiation effects on desoxycytidine level in rats, 18: 19684
radiation effects on 5-hydroxyindoleacetic acid excretion in, by rats, 18: 19626
radiation effects on excretion of amino acids in human, 18: 19638
radiation effects on 5-hydroxyindoleacetic acid excretion in rat, effects of cystamine on, 18: 19639
uranium content in, of miners, 18: 20271
UTAH (SAN JUAN CO.)
geology of mineralogical changes in uranium deposit sediments in, 18: 20228

V

V PARTICLES
relativistic field theory with, 18: 21039
VACCINES
effects on mouse lymph nodes and spleen when used with radiation, 18: 19740
radiation effects on reproduction of smallpox, in tissue culture, 18: 19687
VACUUM
electric arc cathode emission processes in, 18: 20143
electric breakdown in, theory of d-c, 18: 20140
electric breakdown in, theory of, 18: 20139
electric breakdown in, mechanisms of, 18: 20142
radiation effects on engineering materials in, 18: 20581(R) (FZK-172)
VACUUM SEALS
development and testing for high-temperature fission counters and

ionization chambers, 18: 21564(R) (GEMP-81)
VACUUM SYSTEMS
development for bakeout to 400°C, 18: 20618(R) (NP-13799)
VACUUM VALVES
design of, with long life, 18: 20199(T)
VALINE
separation from amines and amino acids by thin-layer chromatography-ionophoresis and ionophoresis, 18: 19854(T) (SC-T-64-49)
VALLECITOS BOILING WATER REACTOR
fuel rod testing in, 18: 21635(R) (GEAP-4481)
stability tests on, 18: 21634 (GEAP-3971)
VAN ALLEN RADIATION BELTS
boundary of outer, at 1000-km, 18: 21071
properties and effects on Aurora (E/T), 18: 21087
proton time-integrated flux for low-acceleration vehicle trajectories in, 18: 20816
VAN DE GRAAFF ACCELERATORS
beam energy fluctuations in, device for reducing, 18: 20709(P)
design concepts, 18: 20708
design for pulsed electrons, 18: 20583 (PAN-473/II)
use for micrometeoroid simulation, 18: 20707
VANADIUM
corrosion by cesium at 750°C, 18: 20873
determination in tantalum by d-c arc method, spectrographic, 18: 19894
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
determination of, optimum sample position in activation, 18: 19906
diffusion in niobium, concentration gradients of, 18: 20512 (ASD-TDR-62-7(Pt.II))
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359
nuclear magnetic resonance in superconducting films of, 18: 21117
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
voltammetry in phosphoric acid–sulfuric acid or sulfuric acid using pyrolytic graphite electrode, 18: 19967
VANADIUM ALLOYS
properties for use as jacket material for fast reactor fuels, 18: 21698(R) (ANL-6860)
Mo–Nb–V–Zr, fabrication of B-66, by extrusion and forging, 18: 20484(R) (AD-418992)
Mo–Nb–V–Zr, fabrication of B-66, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Mo–Nb–V–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated B-66, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Nb–V, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Rh–Ti–V, superconductivity, 18: 21112
Sn–V–Zr, corrosion by steam at 350, 400, and 480°C, 18: 20476(T,R) (EURAEC-916)
Sn–V–Zr, mechanical properties at 20, 200, 500, and 700°C, 18: 20476(T,R) (EURAEC-916)
Ti–V, corrosion by liquid sodium, 18: 21698(R) (ANL-6860)
Ti–V, transformation characteristics during continuous cooling, 18: 20545
V–Zr, crystal structure of, electron microscopic studies of, 18: 20476(T,R) (EURAEC-916)
VANADIUM CARBIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
free energy of formation at 1180 to 1370°K, 18: 19970
VANADIUM IONS
radioinduced in ammonium zinc sulfate, spectra of, 18: 20059
VANADIUM ISOTOPES V-46
beta decay of, half life for, 18: 21306
VANADIUM ISOTOPES V-48
beta decay of, circular polarization of gamma radiation following, 18: 21309
VANADIUM ISOTOPES V-50
abundance ratio to vanadium-51 in ascidians, 18: 19519 (IS-655)
VANADIUM ISOTOPES V-51
abundance ratio to vanadium-50 in ascidians, 18: 19519 (IS-655)
deuteron reactions (d,α) with, differential cross sections for, 18: 21157(R) (AFOSR-5284)
nuclear magnetic resonance in vanadium nitrides, Knight shift and relaxation in, 18: 19980
proton reactions (p,d) at 17 to 18.5 Mev, neutron shell configuration studies from, 18: 21291
VANADIUM NITRIDES
vanadium-51 NMR in, Knight shifts and relaxation in, 18: 19980
VANADIUM OXIDES
Nb_2O_5–V_2O_5, crystal structure of tetragonal phases in, 18: 19942
Ta_2O_5–V_2O_5, crystal structure of tetragonal phases in, 18: 19942
VANADYL IONS
growth in ammonium zinc sulfate, spectra of, 18: 20059
VENTILATION
of uranium mines for control of radon and daughters, 18: 20269
VESPIDAE
genetic evolution in populations of, 18: 19506(T) (TID-20401)
radiation effects on chromosomes of *Hymenolepis diminuta*, gamma, 18: 19752
VIRUSES
radiation effects on reproduction in guinea pigs and mice of parotitis, x, 18: 19556(T) (JPRS-23956(p.9-17))
radiation effects on vaccinia, Shay leukemia development in rats from, uv, 18: 19614
radiation effects on immunity to, review, 18: 19747
radiation effects on smallpox, in tissue culture, 18: 19687
radioinduced myeloid leukemia in mice as affected by Gross, x, 18: 19578
Soviet studies in, 18: 19508(T) (JPRS-23956)
synthesis of whole TMV, cell-free, 18: 21725(R) (TID-20437)
VISCOSITY
theory for quantum systems, 18: 21070
VISION
radiation effects on rabbit, x, 18: 19728
VITAMIN B_2
radiolysis of, electron and x, 18: 20090
VITAMIN B_{12}
radiation effects on mouse kidney and liver content of, x, 18: 19743
VOLATILITY SEPARATION PROCESSES
fuel element threading tool for, 18: 20134(R) (ORNL-TM-792)
VOLUMETRIC ANALYSIS
developments in inorganic, review of, 18: 19865

W

WARFARE
radiation casualties during thermonuclear, 18: 20258
WASTE DISPOSAL
methods for, 18: 20246
of low- and intermediate-level radioactive wastes, 18: 21694
packaging of long-lived fission products, engineering of demonstration facilities for, 18: 21691 (HW-77163)
WASTE PROCESSING
conference on, 18: 21693
evaporation, efficiency and cost of, 18: 21695
of low- and intermediate-level radioactive wastes, 18: 21694
separation of cesium by ion exchange, 18: 20097 (CONF-179-1)
sorption, using ferric hydroxide, 18: 20102 (UJV-850/63)
sorptive properties of clay minerals for strontium-90 for, 18: 21696
WASTE SOLUTIONS
processing low-level, at Kernforschungszentrum, Karlsruhe during 1961 and 1962, 18: 21692
separation of protactinium-231 from uranium-processing, efficiency of ion exchange and solvent extraction for, 18: 20105
WATER
boiling of, surface temperature fluctuations during bubble formation in nucleate, 18: 20162 (EUR-1622.f)
decontamination by chemical precipitation, 18: 20266
determination in soils and building materials, neutron moderation method for, 18: 19905
effects of movement of, on ion movement into tomato root xylem, 18: 21723 (TID-18877)
effects on formation of corrosion resistant films on titanium and zirconium oxides, 18: 20481

fallout uptake by, in England, 18: 20208 (AERE-R-4415)
flow of, critical parameters in two-phase, 18: 20170 (TID-7694(p.11-17))
flow of, heat transfer in two-phase, 18: 20171 (TID-7694(p.18-23))
flow of, pressure drop in two-phase, 18: 20172 (TID-7694(p.24-34))
heat transfer burnout measurements in boiling, design test loop for, 18: 20180 (TID-7694(p.87-8))
heat transfer of boiling, forced- and natural-circulation, 18: 20160(R) (AD-423679)
heat transfer of boiling, forced- and natural-circulation, 18: 20166(R) (NP-13810)
hydrogen isotope fractionation in perchloric acid solutions of, 18: 19968
metabolism and turnover in dogs, tracer study using deuterium, 18: 19530
neutron absorption by, from polonium-beryllium source, 18: 21136
neutron slowing-down time to cadmium edge in, 18: 21148
nuclear magnetic resonance of sorbed, on thorium oxide, temperature dependence of, 18: 20632 (TID-18689)
oxygen-18 exchange with phosphorus acid, mechanism and rate of, 18: 19965
radiolysis in acid, basic, and neutral solutions, review of free radical yields in, 18: 20037 (BNL-6978)
radiolysis in boiling water reactors, hermetic sealing and recombiner problems from, 18: 21672 (NAA-SR-Memo-9507)
radiolysis of, mechanisms of formation of molecular products in electron and gamma, 18: 20050
separation of air and steam from, development of centrifugal separators for, 18: 20128(R) (ACNP-64021)
sorption on beryllium oxide, 18: 20014
x-ray scattering cross sections, 18: 20035
Ar–H_2O, performance in ionization chambers, 18: 20393
dioxane–H_2O, dielectric properties of, 18: 19957
dioxane–H_2O, electric conductivity of lithium-7-labeled lithium chloride in, 18: 19976
HNO_3–TBP–H_2O, calculation of cascade stagewise conditions for rare earth separation, 18: 20098 (IS-780)
N–H_2O, yields from d-c discharges in, 18: 20013
steam–water, flow in vertical tubes, pressure drops in, 18: 20164 (EURAEC-1004)
U–H_2O, neutron physics measurements, 18: 21594 (BNL-6975)

WATER-d_2
deuteron quadrupole relaxation in liquid, measurement of, 18: 19962
production of, sieve tray testing for, 18: 21633(R) (DPST-64-83-1)
proton reactions (p,n) at 6 Bev, 18: 21698(R) (ANL-6860)
dioxane–D_2O, dielectric properties of, 18: 19957
U–D_2O, critical level in, pulsed-neutron determination of, 18: 21595 (CEA-R-2376)
U–D_2O, physics calculations for organic cooled lattices of, 18: 21596 (EUR-597.e)

WATER-i_2
sorption of vapor of, by foamed poly(vinyl chloride), 18: 20458 (USNRDL-TR-717)

WATER COOLED REACTORS
design of steam-cooled water-moderated power, 18: 21662(P)
heat transfer by steam–water mixtures in, 18: 20182 (TID-7694 (p.108-49))

WATER MODERATED REACTORS
design of steam-cooled power, 18: 21662(P)
neutron buckling and reaction rates in, 18: 21591 (AEEW-M-425)
neutron flux distributions in, effects of energy on, 18: 21608

WATER PURIFICATION EQUIPMENT
decontamination factor of Warsaw plant for Vistula River water, 18: 20229 (CLOR-23)

WATER SUPPLIES
contamination of municipal, by nuclear attacks, 18: 20233 (NP-13806)

WATER VAPOR
determination in gases using carbon-14-labeled calcium carbide, 18: 19848 (ORO-591)
reactions with beryllium oxide at 1065 to 1380°C, 18: 20016

WEAR
measurement of tool, radiometric method for, 18: 20426

WELDING
electron-beam methods of, 18: 20491
electron-beam, plutonium bearing fabrication of particulate fuel elements by, 18: 20492
equipment for, development of automatic, 18: 20134(R) (ORNL-TM-792)
methods for aluminum, gas-torch and WIG-, 18: 20490
of reactor steels by electroslag techniques, 18: 20488(T,R) (EURAEC-970)

WELL LOGGING
methods of radiometric, 18: 20225

WHEAT
radiation effects on mutation rate and polyploidy of *Triticum*, x, 18: 19748

WHITE OAK CREEK
flow studies of, use of analog computer in, 18: 20134(R) (ORNL-TM-792)

WIND
fallout dose reduction effects of, 18: 20237 (USNRDL-TR-700)

WIND TUNNELS
design and performance of hypersonic, 18: 20119 (ARL-64-5)

WINDSCALE ADVANCED GAS COOLED REACTOR
fuel elements for, development of dispersion, 18: 21659

WIRES
electroplating of, development of techniques for, 18: 20134(R) (ORNL-TM-792)

X

X RADIATION
biological effects of, relative, 18: 19685
biological effects on cartilages of growing larynx in rabbits, 18: 19700
biological effects on phosphonucleoside contents of organs of rats, 18: 19702
chemical effects on alkali nitrate solutions, 18: 20080
chemical effects on vitamin B_2, 18: 20090
detection and dosimetry of, biological method using chromosomal aberrations for, 18: 19643
dominant lethality in Drosophila oocytes induced by, factors affecting, 18: 19622
Drosophila mosaics induced by, 18: 19618
effects in mice, effects of fetal thymus cell transplantation on, 18: 19766
effects of low-energy, on mammalian tissue cells, wavelength, wavelength dependence of, 18: 19757
effects of, used with antibiotics on scale homograft survival in fish, 18: 19726
effects on amphibian gastrulas, 18: 19649
effects on anesthetized animals, 18: 19612(T)
effects on B^9 chromosomes in maize, use of A-B translocations in mutation studies on, 18: 19513
effects on bacteriophage T1, effects of freeze-drying, low temperature, and sulfhydril compounds on, 18: 19634
effects on *Bacterium paratyphosum* agglutinin production in rabbits, 18: 19738
effects on bilirubin conjugation and excretion in rat liver, 18: 19632
effects on bis(2-guanidoethyl) disulfide and 2-mercaptoethylguanidine distribution and metabolism in mice, 18: 19772
effects on bone marrow repopulation in man and mouse, 18: 19592
effects on catalase activity in *Mycobacterium tuberculosis* strains, 18: 19607
effects on chromosomes in man and mouse, 18: 19583
effects on chymotrypsin kinetics, 18: 19666
effects on color centers in potassium bromides and chlorides at low temperatures, prolonged, 18: 20668
effects on crystal structure of germanium-activated quartz, 18: 20587
effects on degradation process in DNA, repeated, 18: 19656
effects on DNA degradation in *E. coli*, 18: 19641
effects on dog hemopoiesis when used with decortication, 18: 19733
effects on dog leukocytes, 50- *vs.* 250-kvp, 18: 19585
effects on dogs, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and *p*-aminopropiophenone against, 18: 19794
effects on dogs, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and *p*-aminopropiophenone against, 18: 19795
effects on *E. coli* genetic recombination after female irradiation, 18: 19620
effects on electric conductivity of alkali halides, effects of impurities on,

18: 20588
effects on enzymes in guinea pig lungs, 18: 19675
effects on ESR spectra of hexamethylenediammonium adipate single crystal, 18: 20075
effects on fertility and mortality of *Drosophila melanogaster*, 18: 19750
effects on frogs, repair of, 18: 19781(T)
effects on genetic response of Drosophila spermatozoa, 18: 19647
effects on glycogen content of mouse spleen leukocytes, when used with antigens, 18: 19741
effects on hamster lung cells, 18: 19670
effects on HeLa cell fine structure, 18: 19723
effects on hippuric acid synthesis in rat liver, effects of glycine on, 18: 19631
effects on human kidney cells, methods for modification of, 18: 19760
effects on human lymph vessels, 18: 19604
effects on iron-59 uptake by rat mucosa, protective effects of MEA against, 18: 19787
effects on L-cells, restoration of viability following, using isologous subcellular fractions, 18: 19783
effects on lead-doped potassium chloride, bleaching of, 18: 20038 (COO-1044-13)
effects on life span of Drosophila, 18: 19554 (TID-20550)
effects on lymph node plasmacytic reaction in mice and rats, 18: 19557(T) (JPRS-23956(p.18-26))
effects on mice, protective effects of bone marrow against, 18: 19770
effects on mice, protective effects of cysteamine against, 18: 19775
effects on mice, protective effects of 2-(2-aminoethyl)-2-thiopseudourea and bone marrow against, 18: 19796
effects on mice, protective effects of frozen and stored bone marrow against, 18: 19805
effects on Mimosa responses, 18: 19574
effects on monkey and rat responses, 18: 19586
effects on morphogenesis of embryonic chick tibiotarsus, 18: 19657
effects on mouse and rat serum protein metabolism, 18: 19590
effects on mouse bone marrow and spleen, protective effects of homologous cell against, 18: 19767
effects on mouse blood cell and hematopoietic system metabolism, 18: 19730
effects on mouse carbohydrate metabolism, relation to phagocytosis in hematopoietic system, 18: 19734
effects on mouse hind limb circulatory system, 18: 19640
effects on mouse lymphoid regeneration, effects of thymus on, 18: 19546
effects on mouse lymph nodes and spleen when used with vaccination, 18: 19740
effects on mouse mortality, effects of age on spleen cell transfusions for, 18: 19727
effects on mouse splenic uptake of iron-59, 18: 19594
effects on mouse survival, protective effects of cysteamine against, 18: 19788
effects on mouse spleen proteolysis, 18: 19744
effects on mouse transplantation antigens, 18: 19589
effects on mutation rate and polyploidy of *Triticum*, 18: 19748
effects on nervous activity of antenatally irradiated dogs, 18: 19608(T)
effects on nuclear diameters of cells of Walker carcinomas, 18: 19699
effects on optical masers, 18: 20625 (N63-21469)
effects on oxygen consumption by rats, effects of insulin on, 18: 19806
effects on ozone in man, mouse, rats, and rabbits, 18: 19538
effects on parotitis virus in guinea pigs and mice, 18: 19556(T) (JPRS-23956(p.9-17))
effects on phage induction in *E. coli*, 18: 19739
effects on potassium bromide and cyanide crystals, color center formation in, 18: 20040 (COO-1044-15)
effects on potassium iodides, temperature dependence of F-band production rate in, 18: 20656
effects on rabbit lipids, 18: 19561
effects on rabbit metabolism of carbon-14-labeled palmitic acid, 18: 19665
effects on rabbit visual analyzers, 18: 19728
effects on rabbit leukocyte phagocytosis, 18: 19736
effects on rabbit immune reactions to smallpox, 18: 19737
effects on rabbits, restoration effects of immune donor nucleoproteins on, 18: 19765
effects on rat and rabbit immune reactions, 18: 19722
effects on rat bone growth, 18: 19555 (USNRDL-TR-721)
effects on rat ears, 18: 19562
effects on rat hair, protective effects of cystamine and cysteamine against, 18: 19784
effects on rat liver, effects of irradiated bone marrow on, 18: 19790
effects on rat neural system, 18: 19729
effects on rat serum proteins, 18: 19754
effects on rat suprarenals, 18: 19676
effects on rats after abdominal exposure, 18: 19587
effects on rats, chemical protection against, 18: 19779
effects on rats, protective effects of propylthiouracil against, 18: 19780
effects on regeneration of tissues in salamanders and mice, 18: 19553(R) (TID-20513)
effects on reproduction of smallpox virus in tissue culture, 18: 19687
effects on reticulocytes in peripheral blood of patients with dermatologic diseases, 18: 19712
effects on saccharin response in rats, 18: 19667
effects on *Serratia marcescens*, protective effects of chemicals against, 18: 19785
effects on skin in accidental exposure, 18: 19706
effects on skin in treatment of skin carcinomas, 18: 19714
effects on sodium fluoride crystals, temperature dependence of color center growth in, 18: 20039 (COO-1044-14)
effects on sodium chloride coloration and volume, 18: 20598
effects on Stenobothrus germ cell cytochemistry, 18: 19615
effects on strontium-90 uptake in rat teeth, 18: 19655
effects on transplantability of ascites tumor cells, 18: 19651
effects on tritiated cytidine uptake by HeLa cell RNA, 18: 19599
effects on tuberculosis in guinea pigs, 18: 19715
effects on urinary excretion of 5-hydroxyindoleacetic acid in rats, 18: 19626
effects on urinary excretion of 5-hydroxyindoleacetic acid by rats, effects of cystamine on, 18: 19639
effects on vitamin B_{12} in mice, 18: 19743
effects on zinc-65 metabolism by mouse liver, 18: 19531
emission by neutron stars, 18: 20711
emission in proton impact on aluminum, 18: 20734(T) (UCRL-Trans-1050(L))
exposure control in cineradiography, device for, 18: 19829
generation of, flash tubes for, 18: 20308
genetic effects of fractionated doses on embryonic development of mice, 18: 19719
hazards to children, 18: 20263
hematological effects on blood count and protein in animals at 3270 to 5400 r, 18: 19703
histochemical effects on enzyme activity of cells of cervix carcinoma and surrounding cells, 18: 19701
histological effects on testes of rats, 18: 19709
induction of chromosomal aberrations in human skin cultures by, 18: 19563
induction of jute aberrant growth by, 18: 19725
ionization of krypton by, K- and L-shell, 18: 20730 (CONF-481-7)
leukemogenic effects in mice, physical factors affecting, 18: 19577
leukemogenic effects in mice, virus effects on, 18: 19578 18: 19512
leukoplakia induction by, 18: 19624
of mouse tumor bed, effects on unirradiated graft, 18: 19695
pneumonitis induction after lymphosarcoma therapy using, 18: 19566
r-unit absolute measurement in therapy range, 18: 19826
scattering by atoms, parameters for, 18: 20809
scattering by irradiated beryllium oxide, intensity distribution of, 18: 20607
scattering by liquids and solutions, cross sections for, 18: 20035
scattering by single-crystal silicon, small-angle, 18: 20555
scintillator quenching by, 18: 20352
spectra of, emitted from anode in Penning discharge, 18: 21502
therapy of breast carcinomas using, effects on bones, 18: 19673
therapy of cervical carcinoma using, followed by pregnancy, 18: 19565
use in dentistry, exposure from, 18: 20261

used with cortisone, effects on rabbit skin homografts, 18: 19613(T)
X-RAY-ABSORPTION ANALYSIS
developments in, review of, 18: 19862
X-RAY-DIFFRACTION ANALYSIS
developments in, review of, 18: 19866
X-RAY EQUIPMENT
device for exposure control in cineradiography, 18: 19829
flash tubes for roentgen-ray generation, 18: 20308
mercury vapor target tubes, 18: 20653
radiation injuries to right hand from handling of, 18: 19706
X-RAY SPECTRA
limit of continuous, high-frequency, 18: 20653
X-RAY SPECTROSCOPY
developments in, review of, 18: 19862
XENON
buildup in reactors, control of time-to-poison in, 18: 21687
effects on cesium vapor diodes, apparatus for determining, 18: 20856
effects on radiolysis of carbon monoxide, 18: 20087
electric discharge in, plasma constriction in, 18: 21463
electric discharge in low-pressure, instabilities in, 18: 21479
electron multiple scattering at 40 to 130 kev, linear displacement distributions in, 18: 21316
electron scattering at 25 kev, cross sections for and optical transitions in, 18: 20764
interactions with argon atoms, dipole-quadrupole effects on cross sections for elastic, 18: 20733 (WIS-TCI-41)
ionization by electrons, cross sections for, 18: 20768
lithium-7 scattering at 7 to 60 kev, angular distributions from, 18: 21318
pinch effect in, spectroscopic studies of, 18: 21422
radioinduced ionization in thermionic cells, fission fragment, 18: 20860
separation from krypton by gas chromatography, 18: 21707(R) (MLM-1177)
thermionic properties in diodes, 18: 20831 (APL-TDR-64-28)
thermal capacity of liquid, at boiling point, 18: 19929 (CONF-417-20)
XENON FLUORIDES
chemical shifts in, calculation of, 18: 19960
complexes with arsenic and boron fluorides, properties of, 18: 19999
XENON IONS
ionization of monovalent, by electrons, cross sections for, 18: 20768
ranges in silicon crystals at 20 to 80 kev, 18: 20812
reactions with molecules at 15 to 200 ev, charge exchange in, 18: 20742
sputtering on metals at 25 to 60 kev, energy dependence of, 18: 20785
sputtering on metals at 20 to 1000 ev, mass dependence of, 18: 20786
XENON ISOTOPES
separation by thermal diffusion, 18: 21707(R) (MLM-1177)
XENON ISOTOPES Xe-125
ranges in silicon crystals at 20 to 80 kev, 18: 20812
XENON ISOTOPES Xe-129
production in meteorites by iodine-129 decay, 18: 20726
XENON ISOTOPES Xe-131
ranges in metals at 5 to 30 kev, 18: 20672
XENON ISOTOPES Xe-132
content in chondrites, 18: 20726
XENON ISOTOPES Xe-133
diffusion in aluminum oxide and beryllium oxide, 18: 20570
diffusion in thorium(IV) oxide–uranium(IV) oxide dispersions in beryllium oxides, 18: 20572
XENON ISOTOPES Xe-137
beta decay, 18: 21361
XENON OXYFLUORIDES
chemical shifts in, calculation of, 18: 19960
XENON SYSTEMS
O–Xe, radiolysis of, ozone formation in, 18: 20095
XENOTIMES
analysis for rare earths and thorium, 18: 19885
XYLENE
x-ray scattering cross sections, 18: 20035
XYLENOL ORANGE
analytical uses for spectrophotometric determination of rare earths, 18: 19883
XYLOSE
oxidation by bromine, tritium isotope effects in, 18: 20031

Y

YANKEE POWER REACTOR
control of, boric-acid shim, 18: 21652
YEASTS
radiation effects on diploid and polyploid cells of, 18: 19678
radiation effects on enzyme activity in Rhodotorula, protective effects of cystamine against, beta, 18: 19786
YTTERBIUM
compressibility at room temperature, 18: 20553
content and relative abundances in terrestrial materials, 18: 20202
determination in thorium using xylenol orange, spectrophotometric, 18: 19883
electron structure of, measurement from positron annihilation, 18: 20552
helium-3 elastic scattering at 20 Mev, differential cross sections for, 18: 21359
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
stacking-fault energy, 18: 20550
YTTERBIUM COMPLEXES
with arsenazo, composition of, 18: 19948
YTTERBIUM ISOTOPES Yb-164
beta-gamma transitions in, 18: 21174 (JINR-P-1479(p.3-25))
YTTERBIUM ISOTOPES Yb-168
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
YTTERBIUM ISOTOPES Yb-169
use in radiography of aluminum and steel, 18: 20425
YTTERBIUM ISOTOPES Yb-170
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
YTTERBIUM ISOTOPES Yb-171
hyperfine structure and nuclear magnetic moment, 18: 21235
YTTERBIUM ISOTOPES Yb-172
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
YTTERBIUM ISOTOPES Yb-173
hyperfine structure and nuclear magnetic moment, 18: 21235
YTTERBIUM ISOTOPES Yb-174
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
YTTERBIUM ISOTOPES Yb-176
energy levels of, properties of octupole, 18: 21172 (JINR-E-1561)
YTTRIUM
content and relative abundances in terrestrial materials, 18: 20202
determination using 4-(2-pyridylazo)-resorcinol, spectrophotometric, 18: 19895
determination with thorium in monazites, thorium phosphates, and xenotimes, 18: 19885
separation by anion exchange in EDTA, effects of temperature on, 18: 20110
separation from dysprosium by countercurrent electrolytic methods, mass effect in, 18: 20112
separation from fission products by sorption on ferric hydroxide, 18: 20102 (UJV-850/63)
separation from metal ions by ion exchange in isopropyl alcohol, 18: 20104
separation from thorium by solvent extraction using acetyl acetone, 18: 20106
YTTRIUM ALLOYS
Ce–Y, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
Nd–Y, magnetic susceptibility of delta-phase, temperature dependence of, 18: 20519 (IS-551)
Nd–Y, phase diagram, 18: 20520 (IS-841)
Rh–Ti–Y, superconductivity, 18: 21112
YTTRIUM FLUORIDES
analysis for oxygen, 18: 19907
YTTRIUM ISOTOPES Y-88
decay scheme of, removal of fictitious cascades from, 18: 21251
YTTRIUM ISOTOPES Y-89
deuteron reactions (d,p) at 5 to 12 Mev, cross sections and isomer ratios for production of yttrium-90g and -90m in, 18: 21279
helium-3 reactions (He^3,d) with, distorted-wave analysis of, 18: 21204

(LADC-6302)
YTTRIUM ISOTOPES Y-90
electron polarization in, method for measuring longitudinal, 18: 21339
hemorrhagic diathesis induction in dogs by, in labeled DTPA, 18: 19600
production of ground and metastable states of, in rubidium-87 (α,n) and yttrium-89 (d,p) reactions, cross sections and isomer ratios in, 18: 21279
radiation effects on dog lymph system, from labeled DTPA, 18: 19601
use in hypophysectomy, 18: 19824
yields from fission of plutonium-239, uranium-235, and uranium-238, 18: 19516
YTTRIUM ISOTOPES Y-91
metabolism by mice after inhalation in liquid aerosol, 18: 19544
separation from water by chemical precipitation, 18: 20266
uptake from soil by crop plants, 18: 19515 (NP-13796)
YTTRIUM OXIDES
analysis for oxygen, 18: 19907
YTTRIUM OXYSELENIDES
preparation and properties in hydrogen bonding in, 18: 19981
YTTRIUM OXYSULFIDES
preparation and properties of hydrogen bonding in, 18: 19981
YUGOSLAVIA
radiation chemistry activities and development at Boris Kidric Nuclear Science Institute, Vinca, 18: 20082
uranium content in urine of uranium miners in, 18: 20271

Z

ZINC
analysis for europium by chemical stripping, 18: 19851(R) (TID-20548)
analysis for zinc-65 and -69, calculation method for, 18: 20069
determination in lubricants, computer routine for activation, 18: 19918
determination in nucleic acids, activation, 18: 19892
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
exchange in chelating ion resin, self-, 18: 19972
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
sputtering by xenon at 25 to 60 kev, energy dependence of, 18: 20785
superconducting energy gap in polycrystalline, 18: 20627(R) (NP-13815)
use in radiation protection pastes for skin in radiotherapy, 18: 19832
ZINC ALLOYS
Mg–Zn, corrosion of, effects of indium on, 18: 20482
Zn–Zr, itinerant electron ferromagnetism in, 18: 20556
ZINC COMPLEXES
with aminoacetone-N, N-diacetic acid, dissociation and stability constants of, 18: 19946
ZINC ISOTOPES Zn-65
body burden in Alaska, 18: 20231 (HW-SA-3048)
radiation effects on mouse liver metabolism of, x, 18: 19531
ZINC ISOTOPES Zn-68
deuteron reactions (d,He^3) with, analysis of, 18: 21204 (LADC-6302)
ZINC NIOBATES
luminescence of, self-activated, 18: 20060
ZINC SELENIDES
chromium-53 EPR in, parameters for, 18: 20019
ZINC SULFIDES
chromium-53 EPR in, parameters for, 18: 20019
luminescence of, effect of iron ions on, 18: 20003
luminescence of, energy and mass dependence of ion-excited, 18: 20011
ZINC TANTALATES
luminescence of, self-activated, 18: 20060
ZINC TELLURIDES
chromium-53 EPR in, parameters for, 18: 20019
ZINC URANATES
preparation and properties, 18: 20012
ZIRCALOY-2
corrosion by ammonium hydroxide, lithium hydroxide, steam, and water at high temperatures, hydrogen sorption from, 18: 21643(R) (WAPD-MRP-107)
corrosion by steam–water mixtures, 18: 20182 (TID-7694(p.108-49))
corrosion by steam at 350, 400, and 480°C, 18: 20476(T,R) (EURAEC-916)
corrosion mechanisms of, electron microprobe analyses of, 18: 21633(R) (DPST-64-83-1)
creep properties at 550 to 750°F, 18: 20450(R) (BMI-1661(Del.))
hydride phase estimation in process tubes of, metallographic, 18: 20518 (HW-74949)
hydride platelet orientations in tubing of, effects of fabrication and stresses on, 18: 21633(R) (DPST-64-83-1)
sealing to glass, development of methods for, 18: 20134(R) (ORNL-TM-792)
ZIRCALOY-4
corrosion by ammonium hydroxide, lithium hydroxide, steam, and water at high temperatures, hydrogen sorption from, 18: 21643(R) (WAPD-MRP-107)
fabrication and properties of tubes of, with spacing projections, 18: 20450(R) (BMI-1661(Del.))
fatigue properties of, effects of superimposed strain and oxide films on, 18: 20521 (KAPL-3016)
ZIRCONIUM
bonding to zirconium by gas pressure, 18: 20450(R) (BMI-1661(Del.))
corrosion-resistant film production on, in aqueous chlorides and sea water, 18: 20481
determination in industrial solutions, quantometric and spectrographic, 18: 19910
determination in molybdenum, tungsten, and their alloys, classical methods for, 18: 19921
determination in polyphenyls, x-spectrographic, 18: 19844 (ISPRA-455)
determination in tantalum, 18: 19920
determination in uranium alloys, photometric, 18: 19845 (JAERI-1053)
determination in zirconium diboride, 18: 19882
determination simultaneously with hafnium, thorium, and titanium in ores, spectrographic, 18: 19912
determination using aromatic carboxylic acids, gravimetric, 18: 19871
determination using flavonol-2'-sulfonic acid, spectrophotometric, 18: 19884
diffusion of boron and carbon in, conditions for, 18: 20540
diffusion of iron in, temperature dependence of, 18: 20561
formation and combustion of single droplets of, use of flash heating for, 18: 19927 (CONF-322-9)
neutron reactions (n,p) with, optical model analysis of, 18: 21165 (CONF-490-1)
oxidation at 400 to 600°C, kinetics of, 18: 20479
separation from rare earths by ion exchange in isopropyl alcohol, 18: 20104
spectra of, isotopic shifts in, 18: 20002
ZIRCONIUM ALLOYS
analysis for oxygen, activation, 18: 19886
analysis for rare earths, gravimetric, 18: 19839 (BM-RI-6430)
corrosion by superheated steam, 18: 21698(R) (ANL-6860)
fabrication, 18: 21698(R) (ANL-6860)
Cr–Mo–Zr, corrosion by pressurized water and workability of, 18: 20461
Cr–Mo–Zr, heat treatment effects on mechanical properties and microstructure of, 18: 20461
Mo–Nb–V–Zr, fabrication of B-66, by extrusion and forging, 18: 20484(R) (AD-418992)
Mo–Nb–V–Zr, fabrication of B-66, by extrusion, 18: 20487(R) (WANL-PR-(N)-002)
Mo–Nb–V–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated B-66, in air at 70 to 2600°F, 18: 20523(R) (NP-13811)
Mo–Ni–Zr, corrosion by pressurized water and workability of, 18: 20461
Mo–Ni–Zr, heat treatment effects on mechanical properties and microstructure of, 18: 20461
Mo–Ti–Zr, coating of TZM, with platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Mo–Ti–Zr, corrosion of platinum- and platinum–rhodium-clad TZM, by air at 2550°F, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, coating of FS-85, platinum and platinum–rhodium alloy, 18: 20445(R) (AD-434441)
Nb–Ta–W–Zr, corrosion of platinum- and platinum–rhodium-clad FS-85, by air at 2200 and 2550°F, 18: 20445(R) (AD-434441)

Nb–Ta–W–Zr, fabrication of FS-85, by forging, 18: 20484(R) (AD-418992)
Nb–W–Zr, mechanical properties of Pfaudler silicide and TRW chromium–silicon–titanium-coated D-43, in air at 70 to 2500°F, 18: 20523(R) (NP-13811)
Nb–Zr, emissivity measurements at 800 to 5000°K, 18: 20566
Nb–Zr, fabrication effects on superconducting current capacities of, 18: 21098
Rh–Ti–Zr, superconductivity, 18: 21112
Rh–Zr, superconductivity and phase transitions, 18: 21104
Sn–V–Zr, corrosion by steam at 350, 400, and 480°C, 18: 20476(T,R) (EURAEC-916)
Sn–V–Zr, mechanical properties at 20, 200, 500, and 700°C, 18: 20476(T,R) (EURAEC-916)
U–Zr, fabrication and mechanical properties, 18: 20449 (BMI-973(Del.))
V–Zr, crystal structure of, electron microscopic studies of, 18: 20476(T,R) (EURAEC-916)
Zn–Zr, itinerant electron ferromagnetism in, 18: 20556

ZIRCONIUM BORIDES
analysis for boron, carbon, silicon and zirconium, 18: 19882
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
emissivity measurements to 3000°K, equipment for, 18: 20567
heat content at 410 to 1125°K, 18: 19955
preparation by carbothermic reduction of boron and zirconium oxides, 18: 19882

ZIRCONIUM CARBIDES
atomic vibration amplitudes, 18: 19987
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
entropy of formation at 298°K, 18: 19974
thermal expansion, 18: 19987
UC–ZrC, performance of refractory metal coated, as thermionic emitters, 18: 20874

ZIRCONIUM FLUORIDES
BeF_2–LiF–UF_4–ZrF_4, analysis for chromium by amperiometric titration, 18: 19869

ZIRCONIUM HYDRIDES
reactions with carbon and zirconium oxides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
structure of nonstoichiometric beta-, statistical model for, 18: 19959
U–Zr–ZrH_2, properties as rocket reactor fuel, testing of, 18: 21698(R) (ANL-6860)

ZIRCONIUM ISOTOPES Zr-90
nucleon binding energies, energy levels, and potentials for, 18: 21358

ZIRCONIUM ISOTOPES Zr-95
beta decay of, circular polarization of gamma radiation following, 18: 21309
body burden in Alaska, 18: 20231 (HW-SA-3048)
determination in diet and excreta of Japanese, 1962 and 1963, 18: 20232 (JAERI-1057)

ZIRCONIUM NITRIDES
atomic vibration amplitudes, 18: 19987
emissivity measurements to 3000°K, equipment for, 18: 20567
thermal expansion, 18: 19987

ZIRCONIUM OXIDES
emissivity at 800 to 5000°K, relation of structure to, 18: 20566
formation of corrosion resistant films of, in aqueous chlorides and sea water, 18: 20481
properties of fibers of, as filler for plastics, 18: 21709(R) (MLM-1179)
radiation effects on thermal control coatings of, in nuclear spacecraft, 18: 20603
reactions with calcium hydrides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
reactions with carbon and zirconium hydrides at 1000 to 1600°C, hydrogen bonding in, 18: 19981
CaO–La_2O_3–ZrO_2, phase studies, 18: 20538
CaO–UO_2–ZrO_2, fabrication and properties as reactor fuel, 18: 21643(R) (WAPD-MRP-107)
CaO–ZrO_2, phase equilibria in, sub-solidus, 18: 20578
UO_2–ZrO_2, fabrication into pellets for irradiation, 18: 20450(R) (BMI-1661(Del.))
UO_2–ZrO_2, radiation effects on, 18: 20450(R) (BMI-1661(Del.))

ZIRCONIUM SILICIDES
magnetic susceptibility, 18: 20541

ZIRCONIUM SYSTEMS
C–Mo–Ti–Zr, dispersed phase studies in Mo-TZC, 18: 20512 (ASD-TDR-62-7(Pt.II))
U–Zr–ZrH_2, properties as rocket reactor fuel, testing of, 18: 21698(R) (ANL-6860)

ZIRCONS
alpha activity and thorium concentration in, in Conway granite, 18: 20222
gadolinium ion paramagnetic resonance in, 18: 19945
hardness of crystalline, micro-, 18: 19953

ZOE REACTOR
environs monitoring, 1961 and 1962, 18: 20209 (CEA-2397)

REPORT NUMBER INDEX

Reports, numbered translations, and patents abstracted during the period are included in this index. Each item is listed by report number; this is followed by the abstract number and a brief notation regarding public availability. The index entries show, when known, which reports are on file in the depository libraries, which reports have been published in open-literature journals (journal citation given), and which reports can be purchased (source and price). Whenever a report is identified by more than one number, cross references from secondary to primary report numbers are cited.

The report number codes apply to AEC reports unless designated otherwise. Non-AEC reports are identified by parenthetical notes after the report codes; e.g., (non-AEC), (British), (Canadian), (French). The note (Misc.) identifies those codes used for both USAEC and non-AEC reports. Patents are listed under the heading "PATENTS"; the country of origin is included in parentheses.

A comprehensive listing of both AEC and non-AEC report codes is contained in TID-85(3rd Rev.), *Report Number Series Used by the Division of Technical Information in Cataloging Reports*, to be published.

Public Availability of USAEC Reports

All USAEC reports abstracted in *NSA* are available to the public through one or more of the following sources:

(1) Depository libraries in the United States, in other countries, and in international agencies. A list of these depositories, many of which have facilities for preparing photocopy for sale, appears on the inside covers of each issue of *NSA*.

(2) Scientific and technical journals or other publications.

(3) Microcard Editions, Inc., in Microcard and micronegative form. Orders and inquiries should be sent to: Accounting and Shipping Department, West Salem, Wisconsin 54669.

(4) Office of Technical Services, U. S. Department of Commerce, Washington, D. C. 20230, for sale as full-size printed copy, photostat or facsimile (Xerox), and microfilm.

(5) Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, for sale as full-size printed copy.

Public Availability of Non-AEC Reports

U. S. Reports. Many reports of U. S. Government agencies other than the AEC can be obtained by the public in the same manner as AEC reports. The availability of these reports is given when known. If availability is not shown, inquiries should be directed to the Office of Technical Services. Inquiries concerning "NP" reports should be by title and author rather than by report number.

Non-U. S. Reports. Many reports of atomic energy establishments of other countries are deposited in the libraries listed on the inside covers of each issue of *NSA*.

Additionally, the following countries have made their reports available as indicated.

BELGIUM

Centre d'Étude de l'Énergie Nucléaire. Available upon request to individuals and organizations, from the Centre d'Étude de l'Énergie Nucléaire (CEN), 31, Rue Belliard Bruxelles, Belgium.

CANADA

Atomic Energy of Canada Limited. For sale by the Technical Information Officer, Atomic Energy of Canada Limited, Chalk River, Ontario, Canada. Copies are also deposited in libraries in the United Kingdom.

National Research Council of Canada. Available from the National Research Council of Canada, Ottawa 2, Ontario, Canada.

DENMARK

Atomic Energy Commission Research Establishment, Risø. Available on exchange from the Library, Danish Atomic Energy Commission, Risø, Roskilde, Denmark. Also for sale by Jul. Gjellerup, Booksellers, 87 Sölvgade, København K., Denmark.

Danatom. Available on loan from Research Establishment, Risø, Roskilde, Denmark. Copies are available from Danatom, Aurehøjvej 2, Hellerup, Denmark.

FRANCE

Commissariat à l'Energie Atomique. Inquiries should be addressed to Commissariat à l'Energie Atomique, Service Central de Documentation, Centre d'Etudes Nucléaires de Saclay, Boite Postale No. 2, Gif-sur-Yvette (S.&O.) France.

GERMANY

Deutsches Elektronen-Synchrotron DESY. Copies are available from Deutsches Elektronen-Synchrotron Desy, Dokumentation, 2000 Hamburg-Gr. Flottbek 1, Notkestieg 1, Germany.

Kernforschungsanlage. Copies may be ordered from Zentralbibliothek der Kernforschungsanlage Jülich, Jülich, Bundesrepublik Deutschland.

Hahn-Meitner-Institute für Kernforschung. Available without charge from Hahn-Meitner-Institute für Kernforschung Berlin, Bibliothek, Glienicker Strasse 100, 1 Berlin 39, Germany. Copies are deposited in many national nuclear centers in the world.

ISRAEL

Israel Atomic Energy Commission. Available without charge from Ministry of Defence/Atomic Energy Commission, Soreg Research Establishment, Yavne, Israel. Copies are deposited in libraries in Israel and in other countries.

ITALY

Centro Informazioni Studi Esperienze (CISE). For sale at CISE Press Office, Casella Postale 3986, Milano, Italy. Copies are deposited in libraries in Italy.

Comitato Nazionale per l'Energia Nucleare. Copies are available from Comitato Nazionale per l'Energia Nucleare, Divisione Affari Internazionali e Studi Economici, Ufficio Pubblicazioni Via Belisario, 15, Roma, Italy.

JAPAN

Japan Atomic Energy Research Institute (JAERI). Available from the Staff Supply Cooperative of Japan Atomic Energy Research Institute (JAERI), 1-1 Tamura-Cho, Shiba, Minato-Ku, Tokyo, Japan. Copies are deposited in depositories in Tokyo, Nagoya, and Osaka.

Nagoya University. Copies are available from Research Information Center, Institute of Plasma Physics, Nagoya University, Nagoya, Japan.

University of Tokyo. Available free of charge from Institute for Nuclear Study, University of Tokyo, Tanashi-Machi, Kitatama-gun, Tokyo, Japan.

NETHERLANDS

Reactor Centrum Nederland. For sale by Reactor Centrum Nederland, 112 Scheveningseweg, 's-Gravenhage, The Netherlands. Copies are deposited in university libraries in Holland and in many national nuclear centers in the world.

NORWAY

Forsvarets Forskningsinstitutt. Copies available from Norwegian Defence Research Establishment, Library, P. O. Box 25, Kjeller, Norway.

Institut for Atomenergi. "KR" reports are available on an exchange basis from the Library, Institute for Atomenergi, Box 40, Kjeller, Norway. Other series are not generally available to the public.

Norwegian Reactor School. Copies are available from The Library, Institute for Atomenergi, P. O. Box 40, Kjeller, Norway.

PAKISTAN

Atomic Energy Center. Copies are available from Atomic Energy Center, P. O. Box 658, Lahore, (West Pakistan).

SPAIN

Junta de Energia Nuclear. "JEN" reports are available without charge from Servicio de Documentation, Junta de Energia Nuclear, Ciudad Universitaria, Madrid (3), Spain.

SWEDEN

Aktiebolaget Atomenergi. "AE" reports are for sale from Aktiebolaget Atomenergi, Library Section, Box 43041, Stockholm 43, Sweden. Bibliographies and literature surveys of the VDDIT-series may be obtained from Aktiebolaget Atomenergi, Information Office, Scientific and Technical Information, Box 43041, Stockholm 43, Sweden. Other series are not available generally to the public. Organizations in the atomic energy field may obtain copies from Aktiebolaget Atomenergi, Microcopy of AE reports is available from the International Documentation Centre, Tumba, Sweden.

SWITZERLAND

CERN European Organization for Nuclear Research. Available without charge from CERN European Organization for Nuclear Research, Geneva 23, Switzerland. Copies are deposited in libraries in 13 countries.

Eidgenössisches Institut für Reaktorforschung. "EIR" reports are available from Eidgenössiches Institut für Reaktorforschung, c/o Bibliothek, Würenlingen/AG, Switzerland.

TURKEY

Turkish Atomic Energy Commission. Copies are available free of charge from T.A.E.C., Çekmece Nuclear Research Center, P. O. Box 1, Airport, Istanbul, Turkey.

UNITED KINGDOM

United Kingdom Atomic Energy Authority. Some reports are for sale in the United States by the British Information Service (BIS), 45 Rockefeller Plaza, New York, N. Y. 10022. United Kingdom reports generally may be purchased from Her Majesty's Stationery Office, London. Copies not for sale by Her Majesty's Stationery Office may be purchased in microcopy form from Micro Methods Limited, East Ardsley, Wakefield, Yorks, England. Report copies are deposited in a large number of libraries in England.

Abbreviations Used in Availability Column

AECL	For sale by Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada.
BIS	For sale by the British Information Service, 45 Rockefeller Plaza, New York, N. Y. 10022.
Dep.	AEC reports: Full-size copy is on deposit in the depository libraries both in and outside the United States. These reports are also for sale by Microcard Editions, Inc., Accounting and Shipping Department, West Salem, Wisconsin 54669. Non-AEC reports: Full-size copy on deposit in the depository libraries in the United States only.
Dep.(mc)	Same as for Dep., except copy is in Microcard form.
DSIR	For sale by the Department of Scientific and Industrial Research, Lending Library Unit, 20 Chester Terrace, London, N. W. 1, England.
DTI Extension	Available from the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.
EM	Blueprints and Microcopy of AEC engineering drawings are available from Clearing House for Federal Scientific and Technical Information, National Bureau of Standards, U. S. Department of Commerce, Springfield, Virginia. Current prices of the CAPE- packages may be obtained from this address. TID-4100, available from the Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831, contains information on all the CAPE- packages for sale.
Gmelin	Available at a nominal charge and under the AED- number shown from Atomic Energy Documentation Center, Gmelin Institute, 40-42 Varrentrappstrasse, Frankfurt (Main), West Germany.
GPO	For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.
HMSO	Her Majesty's Stationery Office, London.
IAEA	Available from the International Atomic Energy Agency.
JCL	For sale by the Special Libraries Association Translation Center, John Crerar Library, 35 West 33rd Street, Chicago, Illinois 60616.
LC	For sale by the Library of Congress, Photoduplication Service, Washington, D. C. 20540.
NAS	National Academy of Sciences, National Research Council, Washington, D. C. 20418.
NRC	For sale by the National Research Council of Canada, Ottawa, Ontario, Canada.
ORINS	Available on interlibary loan from the Library, Oak Ridge Institute of Nuclear Studies, Post Office Box 117, Oak Ridge, Tennessee 37831.
OTS	For sale by the Office of Technical Services, Department of Commerce, Washington, D. C. 20230.
UKAEA, London	Available from United Kingdom Atomic Energy Authority, 11 Charles II Street, London, S. W. 1.
USGS	Available free-of-charge from the U. S. Geological Survey, Washington, D. C. 20242.

[The symbols "ph," "mf," and "fs" are used to designate that copy is available only in photostat, microfilm, or facsimile (Xerox) form.]

Report No.	Abstract No.	Availability
A–	**(Misc.)**	
920057-3	18-21379	See N63-13602
A&ES–	**(Non-AEC)**	
63-7	18-21385	See NP-13863
AAEC-E–	**(Australian)**	
115	18-20579	Dep.(mc)
116	18-20483	Dep.(mc)
AAEC-TM–	**(Australian)**	
227	18-20276	Dep.(mc)
ACNP–	**(Misc.)**	
63033	18-21628	Dep.(mc); $9.60(fs), $3.74(mf) OTS
63638	18-21629	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64021	18-20128	Dep.(mc); $7.60(fs), $2.60(mf) OTS
AD–	**(Misc.)**	
402668	18-21205	For addendum see NP-13807
412421	18-20728	$8.60(OTS)
414353	18-20526	See RADC-TDR-63-269
415324	18-21368	See AFCRL-63-161
416199	18-20443	$3.60(OTS)
416652	18-19547	See AMRL-TDR-63-71
417111	18-20444	
417148	18-20893	See AFOSR-5287
417200	18-20710	See AFCRL-62-497
417336	18-20621	See AFCRL-62-1075
417349	18-21157	See AFOSR-5284
417574	18-20832	See GA-4511
418121	18-21676	See SSD-TDR-63-217
418200	18-21443	See AFOSR-5220
418992	18-20484	$1.10(OTS)
419023	18-21374	See GNE/PHYS/63-2
419057	18-20833	See GA/PHYS/63-11, 12
419855	18-20447	See ASD-TR-7-797(IX)
423679	18-20160	$3.60(OTS)
425593	18-20446	See ASD-TDR-63-766
429133	18-21367	$5.60(OTS)
429503	18-20829	$1.75(OTS)
432464	18-20830	$4.60(OTS)
432594	18-20525	See R63SD89
433615	18-21120	See AMRA-TR-63-25
433625	18-20891	$5.60(OTS)
433782	18-20452	See DMIC-195
433804	18-19521	See USNRDL-TR-716
434046	18-20042	See USNRDL-TR-718
434059	18-20892	$2.60(OTS)
434176	18-20813	$3.60(OTS)
434218	18-20458	See USNRDL-TR-717
434219	18-19555	See USNRDL-TR-721
434441	18-20445	$3.60(OTS)
434540	18-20814	$9.10(OTS)
ADR–	**(Non-AEC)**	
09-06b-62	18-20277	
AEC-tr–		
6313	18-20536	Dep.; $6.00(OTS)
6385	18-21644	Dep.(mc); $3.60(fs), $1.16(mf) JCL
AECL–	**(Canadian)**	
1101(Add.)	18-21167	See CRRP-1191
1910	18-21166	See CRRP-1183
1927	18-21225	Can. J. Phys., 42: 762-5(1964)
AEEW-M–	**(British)**	
425	18-21591	Dep.; $0.60(BIS); 3s. (HMSO)
AEEW-R–	**(British)**	
135	18-21610	Dep.(mc); $4.50(BIS); 24s. (HMSO)
178	18-20161	Dep.; $1.40(BIS); 7s. (HMSO)
329	18-20278	Dep.; $1.20(BIS); 6s. (HMSO)
351	18-21156	Dep.; $1.40(BIS); 7s. (HMSO)
AERE-M–	**(British)**	
1289	18-20745	Phil. Mag. (8), 9: 343-7(1964)
1360	18-19923	Dep.; $0.30(BIS); 1s. 9d. (HMSO)
AERE-R–	**(British)**	
4335	18-20355	Nucl. Instr. Methods, 25: 237-43(1964)
4403	18-20594	Phil. Mag. (8), 9: 81-98(1964)
4415	18-20208	Dep.; $0.80(BIS); 4s. (HMSO)
4433	18-20595	Phil. Mag. (8), 9: 161-6(1964)
4537	18-19924	Dep.; $0.80(BIS); 4s. (HMSO)
AFCRL–	**(Non-AEC)**	
62-497	18-20710	$19.75(OTS)
62-1075	18-20621	$4.60(OTS)
63-161	18-21368	$13.00(OTS)
AFOSR–	**(Misc.)**	
1030	18-20836	See R61SD066
5220	18-21443	$13.00(OTS)
5284	18-21157	$2.60(OTS)
5287	18-20893	$3.60(OTS)
AGN–	**(Misc.)**	
8065	18-19925	Dep.(mc); $5.60(fs), $1.85(mf) OTS
AMRA-TR–	**(Non-AEC)**	
63-25	18-21120	$5.60(OTS)
AMRL-TDR–	**(Non-AEC)**	
63-71	18-19547	$1.25(OTS)
ANL–		
6271	18-21592	Dep.; $3.50(OTS)
6860	18-21698	Dep.; $2.25(OTS)
ANL-Trans–		
7	18-21732	Dep.(mc); $1.60(fs), $0.80(mf) JCL
9	18-21683	Dep.(mc); $2.60(fs), $0.86(mf) JCL or OTS
APDA–	**(Misc.)**	
157	18-21593	Dep.(mc)
APEX–		
603(Del.)	18-21561	Dep.(mc); $11.50(fs), $4.76(mf) OTS
APL-TDR–	**(Non-AEC)**	
64-27	18-21666	
64-28	18-20831	
ARA–	**(Non-AEC)**	
1054	18-20200	
ARL–	**(Non-AEC)**	
64-5	18-20119	
64-29	18-20129	
AROD–	**(Misc.)**	
2427:1	18-20325	
2734:2	18-20468	
ASD-TDR–	**(Non-AEC)**	
62-7(Pt.II)	18-20512	
62-670(Pt.II)	18-20485	OTS
63-766	18-20446	

Report No.	Abstract No.	Availability
ASD-TR–	**(Non-AEC)**	
7-797(IX)	18-20447	$4.60(OTS)
ATN–	**(Non-AEC)**	
64(9233)-8	18-21369	
BATT–	**(Non-AEC)**	
4673-FINAL	18-19926	
BAW–	**(Misc.)**	
1280	18-21667	Dep.(mc); $7.60(fs), $2.51(mf) OTS
BM-RI–	**(Misc.)**	
6430	18-19839	Free(Bureau of Mines)
6436	18-20448	Free(Bureau of Mines)
BMI–	**(Misc.)**	
973(Del.)	18-20449	Dep.(mc); $4.60(fs), $1.70(mf) OTS
1384	18-21543	Dep.(mc); $3.60(fs), $1.40(mf) OTS
1661(Del.)	18-20450	Dep.; $1.50(OTS)
BN–	**(Misc.)**	
6401-03	18-20460	For translation see EURAEC-965
BNL–		
6584	18-19769	Ann. N. Y. Acad. Sci., 114: 510-27(1964)
6676	18-20309	Rev. Sci. Instr., 34: 868-72(1963)
6966	18-19812	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6975	18-21594	Dep.(mc); $12.00(fs), $5.24(mf) OTS
6978	18-20037	Dep.(mc); $2.60(fs), $0.95(mf) OTS Radiation Res., Suppl. 4, 54-73(1964)
7007	18-19518	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7053	18-20185	Intern. J. Heat Mass Transfer, 7: 431-46 (1964)
7117	18-20186	Nucl. Sci. Eng., 19: 48-57(1964)
7131	18-19586	Ann. N. Y. Acad. Sci., 114: 316-27(1964)
7224	18-19602	Blood, 23: 471-87(1964)
7250	18-19968	J. Phys. Chem., 68: 744-51(1964)
7461	18-21142	Nucl. Sci. Eng., 19: 80-90(1964)
7462	18-21143	Nucl. Sci. Eng., 19: 91-4(1964)
7530	18-19977	J. Phys. Chem., 68: 978-9(1964)
7566	18-19971	J. Phys. Chem., 68: 884-8(1964)
7575	18-20291	IEEE (Inst. Elec. Electron. Engrs.), Trans. Nucl. Sci., NS-11: No. 2, 16-23 (1964)
7652	18-20061	J. Phys. Chem., 68: 731-6(1964)
7687	18-21293	Phys. Rev., 134: B779-82(1964)
7704	18-21048	Phys. Rev., 134: B743-7(1964)
7765	18-20958	Phys. Rev. Letters, 12: 465-7(1964)
7786	18-20758	Proc. Natl. Acad. Sci. U. S., 51: 664-71(1964)
7836	18-21158	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7839	18-19504	$5.60(fs), $1.79(mf) OTS
7841	18-21699	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7853	18-20326	Dep.(mc); $2.60(fs), $1.04(mf) OTS
7855	18-21700	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7867	18-20279	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7880	18-20327	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7893	18-20556	Phys. Rev. Letters, 12: 444-7(1964)
7899	18-20952	Phys. Rev. Letters, 12: 423-5(1964)
7912	18-19505	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7925	18-21701	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7926	18-19548	Dep.(mc); $3.60(fs), $1.28(mf) OTS
7932	18-20328	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7933	18-20329	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7948	18-20815	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7958	18-21121	Dep.(mc); $3.60(fs), $1.16(mf) OTS
7964	18-20580	Dep.(mc); $2.60(fs), $0.95(mf) OTS
7969	18-20894	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7971	18-21702	$2.60(fs), $1.04(mf) OTS

Report No.	Abstract No.	Availability
BRL-Memo–	**(Misc.)**	
1223	18-21544	
CEA–	**(French)**	
2385	18-20469	Dep.(mc)
2387	18-21612	Dep.(mc)
2388	18-20330	Dep.(mc)
2390	18-20451	Dep.(mc)
2397	18-20209	Dep.(mc)
2399	18-21159	Dep.(mc)
CEA-R–	**(French)**	
2376	18-21595	Dep.(mc)
2401	18-21562	Dep.(mc)
2410	18-21370	Dep.(mc)
2419	18-19840	Dep.(mc)
CEA-tr–	**(French)**	
R-1711	18-19853	Dep.(mc); $6.60(fs), $2.15(mf) JCL or OTS
CERN–	**(European Organization for Nuclear Research)**	
64-6	18-20895	Dep.(mc)
64-14	18-20679	Dep.(mc)
64-21	18-20280	Dep.(mc)
516 and Apps.	18-20438	Dep.(mc)
CISE-R–	**(Italian)**	
83	18-20164	See EURAEC-1004
89	18-20163	See EURAEC-952
CLM-R–	**(British)**	
33	18-21371	Dep.; $0.90(BIS); 4s. 6d. (HMSO)
34	18-21372	Dep.; $0.80(BIS); 4s. (HMSO)
CLOR–	**(Polish)**	
20	18-20210	Dep.
23	18-20229	Dep.
24	18-20211	Dep.
CNLM–	**(Misc.)**	
4234	18-20513	Dep.(mc); $2.60(fs), $1.10(mf) OTS
4479	18-20514	Dep.(mc); $3.60(fs), $1.25(mf) OTS
CONF-24–	**(4th Symposium [on] Engineering Aspects of Magnetohydrodynamics, Berkeley, Calif., Apr. 1963)**	
22	18-20634	See UCRL-7177
CONF-48–	**(Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1963)**	
5	18-19920	ORINS
6	18-19921	ORINS
CONF-63–	**(American Physical Society 1962 Summer Meeting in the West, Seattle, Aug. 1962)**	
5	18-20753	Phys. Rev., 134: A898-915(1964)
6	18-20754	Phys. Rev., 134: A916-22(1964)
CONF-73–	**(6th Biennial Conference on Carbon, Pittsburgh, June 1963)**	
22	18-19931	See EUR-542.e
CONF-75–	**(Sixth International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963)**	
8	18-21375	See MATT-236
CONF-84–	**(American Industrial Health Conference, Cincinnati, May 1963)**	
3	18-21704	See HW-SA-3028

Report No.	Abstract No.	Availability
CONF-117–	**(American Chemical Society 145th National Meeting, New York, Sept. 1963)**	
41	18-21730	See UCRL-10446
CONF-164–	**(Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963)**	
11	18-19813	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-100-17
CONF-176–	**(Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963)**	
6	18-20286	See UCRL-7327
CONF-179–	**(American Chemical Society Radionuclidic Exchange on Soils, Minerals, and Resins, Philadelphia, Apr. 1964)**	
1	18-20097	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-182–	**(9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963)**	
5	18-20327	See BNL-7880
6	18-20279	See BNL-7867
7	18-21158	See BNL-7836
8	18-20344	See UCRL-11261
9	18-21699	See BNL-7841
10	18-20326	See BNL-7853
11	18-20343	See UCRL-11147
CONF-187–	**18-381**	**(American Nuclear Society Meeting, New York, Nov. 1963)**
111	18-21549	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-225-83
112	18-19841	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-225-87
117	18-21680	ORINS. Gmelin, AED-CONF-63-225-97
120	18-20603	ORINS. Gmelin, AED-CONF-63-225-97
122	18-21656	ORINS. Gmelin, AED-CONF-63-225-100
123	18-21155	ORINS. Gmelin, AED-CONF-63-225-101
CONF-201–	**(Pacific Annual Meeting, Spokane, Aug. 1963)**	
3	18-21741	New York, Institute of Electrical and Electronics Engineers, 1963, Preprint Paper 63-1236, ORINS
CONF-209–	**(American Vacuum Society Meeting, Boston, Oct. 1963)**	
27	18-20158	ORINS. Gmelin, AED-CONF-63-161-33
CONF-222–	**(10th National Symposium on Reliability and Quality Control, Washington, D. C., Jan. 1964)**	
2	18-21719	See SC-R-748
CONF-231–	**(International Conference on Fundamental Aspects of Weak Interactions, Upton, N. Y., Sept. 1963)**	
5	18-21160	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-153-4
CONF-243–	**(American Nuclear Society Conference on Problems of Operating Research and Power Reactors, Ottawa, Oct. 1963)**	
51	18-21687	ORINS. Gmelin, AED-CONF-63-168-52
52	18-21688	ORINS. Gmelin, AED-CONF-63-168-40
53	18-21655	ORINS. Gmelin, AED-CONF-63-168-51
CONF-250–	**(American Physical Society 1963 Summer Meeting in the West, Edmonton, Can., Aug. 1963)**	
19	18-21359	ORINS. Gmelin, AED-CONF-63-131-18
CONF-258–	**(Sodium Components Development Program Information Meeting, Palo Alto, Calif., Aug. 1963)**	
2	18-21571	See NAA-SR-Memo-9003
CONF-281–	**(International Conference on Beryllium Oxides, Sydney, Oct. 1963)**	
6	18-20605	ORINS
7	18-20503	ORINS
8	18-20505	ORINS
9	18-20500	ORINS
10	18-20577	ORINS
11	18-20608	ORINS
12	18-20607	ORINS
13	18-20609	ORINS
14	18-20610	ORINS
15	18-20604	ORINS
16	18-20606	ORINS
17	18-20613	ORINS
18	18-20612	ORINS
19	18-20614	ORINS
20	18-20611	ORINS
21	18-20576	ORINS
22	18-20574	ORINS
23	18-20575	ORINS
24	18-20017	ORINS
25	18-21660	ORINS
26	18-20502	ORINS
27	18-20499	ORINS
28	18-20462	ORINS
29	18-20570	ORINS
30	18-20573	ORINS
31	18-20571	ORINS
32	18-20498	ORINS
33	18-20497	ORINS
34	18-20504	ORINS
35	18-20615	ORINS
36	18-20572	ORINS
37	18-20015	ORINS
38	18-20014	ORINS
39	18-20016	ORINS
40	18-21658	ORINS
41	18-21659	ORINS
42	18-20116	ORINS
50	18-20501	ORINS
CONF-284–	**(National Electronics Conference on Adaptive Processes, Chicago, Oct. 1963)**	
9	18-21540	ORINS. Gmelin, AED-CONF-63-170-5
CONF-296–	**(Symposium on Unimolecular Reactions in the Mass Spectrometer and Related Topics in Chemical Kinetics, Salt Lake City, July 1963)**	
4	18-21703	Dep.(mc); $4.60(fs), $1.49(mf) OTS; Gmelin, AED-CONF-63-144-8
CONF-307–	**(Canadian Electronics Conference, Toronto, Ont., Canada, Sept.-Oct. 1963)**	
3	18-21118	ORINS. Gmelin, AED-CONF-63-165-3
CONF-313–	**(2nd National Meeting of the Society for Applied Spectroscopy, San Diego, Calif., Oct. 1963)**	
10	18-19918	ORINS. Gmelin, AED-CONF-63-175-21
11	18-19922	ORINS. Gmelin, AED-CONF-63-175-9
CONF-320–	**(International Conference on Cosmic Rays, Jaipur, India, Dec. 1963)**	
2	18-20815	See BNL-7948
CONF-322–	**(American Chemical Society Production Technology of Np-237 and Pu-238, Denver, Jan. 1964)**	
9	18-19927	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-002-2 J. Phys. Chem. 68: 1268-70(1964)
10	18-20022	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-002-3

Report No.	Abstract No.	Availability
CONF-330–		**(Proceedings of the Van Slyke Symposium, Upton, N. Y., Mar. 1963)**
3	18-19504	See BNL-7839
CONF-331–		**(The Metallurgical Society of American Institute of Mechanical Engineers Annual Meeting, Dallas, Feb. 1963)**
4	18-20454	See LADC-5561
CONF-354–		**(Accelerator Conference, Boston, Mass., Nov. 1963)**
8	18-20708	ORINS. Gmelin, AED-CONF-63-221-9
9	18-20707	ORINS. Gmelin, AED-CONF-63-221-1
CONF-356–		**(1963 American Society of Metals/Metals and Materials Show, Cleveland, Oct. 1963)**
11	18-20515	Dep.(mc); $7.60(fs), $2.42(mf) OTS; Gmelin, AED-CONF-63-223-5
CONF-362–		**(2nd Symposium on Radiochemistry in Man, Chicago, Sept. 1962)**
2	18-20337	See NYO-2553-1
CONF-372–		**(Annual Pittsburgh Diffraction Conference, Pittsburgh, Nov. 1963)**
2	18-20020	ORINS. Gmelin, AED-CONF-63-206-1
3	18-20578	ORINS
CONF-375–		**(6th National Symposium Society for Aerospace Material Process Engineers, Seattle, Nov. 1963)**
7	18-20496	ORINS. Gmelin, AED-CONF-63-224-1
CONF-393–		**(American Institute of Chemical Engineers Symposium on Techniques at High Pressures, Memphis, Feb. 1964)**
2	18-21689	New York, American Inst. of Chemical Engineers, 1964, Preprint 13e, $0.50. ORINS
3	18-21697	New York, American Inst. of Chemical Engineers, 1964, Preprint 18e. $0.50. ORINS
4	18-21119	New York, American Inst. of Chemical Engineers, 1964, Preprint 21b, $0.50. ORINS
CONF-396–		**(Symposium on Nuclear Spectroscopy with Direct Reactions, Argonne, Ill., Feb. 1964)**
6	18-21204	See LADC-6302
CONF-405–		**(4th Rare Earth Research Conference, Phoenix, Ariz., Apr. 1964)**
6	18-19928	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7	18-20520	See IS-841
CONF-416–		**(American Physical Society Division of Fluid Dynamics, Cambridge, Mass., Nov. 1963)**
2	18-20678	ORINS. Gmelin, AED-CONF-63-226-14
CONF-417–		**(American Physical Society Meeting, Pasadena, Calif., Dec. 1963)**
20	18-19929	Dep.(mc); $2.60(fs), $1.10(mf) OTS; Gmelin, AED-CONF-63-253-26
22	18-21541	ORINS. Gmelin, AED-CONF-63-253-28
24	18-21357	ORINS. Gmelin, AED-CONF-63-253-21
25	18-21021	ORINS. Gmelin, AED-CONF-63-253-23
26	18-21161	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-253-32
27	18-20727	ORINS. Gmelin, AED-CONF-63-253-31
28	18-21539	ORINS. Gmelin, AED-CONF-63-253-33
CONF-425–		**(Conference on Nonfissile Metals for Nuclear Reactors, Bologna, Dec. 1963)**
2	18-20517	See EUR-1613.i
CONF-433–		**(American Society Testing Materials, 1964 International Conference on Materials, Philadelphia, Feb. 1963)**
2	18-20120	ORINS. Gmelin, AED-CONF-64-001-2
3	18-20157	ORINS. Gmelin, AED-CONF-64-001-1
CONF-435–		**(XXV Annual Congress of the Group for Advancement of Spectroscopic Methods, Paris, June 1963)**
2	18-19844	See ISPRA-455
CONF-439–		**(American Physical Society 1961 Annual Meeting, New York, Feb. 1961)**
1	18-21293	Phys. Rev., 134: B779-82(1964)
CONF-442–		**(Parkinson Symposium, Washington, D. C., Nov. 1963)**
1	18-21700	See BNL-7855
CONF-446–		**(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)**
2	18-21132	See RPI-328-4
CONF-453–		**(IAEA Symposium on Medical Radioisotope Scanning, Athens, Apr. 1964)**
1	18-19814	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3	18-19834	ORINS
4	18-20416	ORINS
5	18-19835	ORINS
CONF-456–		**(18th Annual Symposium on Fundamental Cancer Research and Cellular Radiation Biology, Houston, Tex., Mar. 1964)**
2	18-21701	See BNL-7925
CONF-462–		**(The Faraday Society, General Discussion, Chemical Reactions in the Atmosphere, Edinburgh, Scotland, Apr. 1964)**
1	18-20095	ORINS
2	18-21092	ORINS
3	18-20810	ORINS
4	18-21093	ORINS
5	18-20021	ORINS
6	18-21094	ORINS
CONF-463–		**(American Society of Mechanical Engineers, Production Engineering and ASTME Conference and Exposition, Detroit, Apr. 1964)**
1	18-20426	New York, American Society of Mechanical Engineers, 1964, Preprint Paper 64-Prod-7, ORINS
CONF-464–		**(Society of Automotive Engineers Meeting, Detroit, Mar.-Apr. 1964)**
1	18-20425	New York, Society of Automotive Engineers, 1964, Preprint 828A, ORINS
CONF-465–		**(American Society of Mechanical Engineers Gas Turbine Conference and Products Show, Houston, Mar. 1964)**
1	18-21679	New York, American Society of Mechanical Engineers, 1964, Preprint Paper 64-GTP-23, $1.00. ORINS
CONF-467–		**(European Atomic Energy Society Symposium on Liquid Metals, Aix-en-Provence, France, Sept.-Oct. 1963)**
1	18-21661	ORINS
2	18-19919	ORINS
3	18-20194	ORINS
4	18-20464	ORINS
5	18-21657	ORINS
6	18-20192	ORINS
7	18-20193	ORINS
CONF-468–		**(Conference on Some Aspects of the Physics of Plasma,**

Report No.	Abstract No.	Availability
	Milan, May 1963)	
1	18-21373	See EUR-495.i
CONF-469–	(Conference on Physics of Reactors, Milan, Nov.-Dec. 1963)	
1	18-21122	See EUR-1605.e
2	18-21596	See EUR-597.e
CONF-470–	(3rd Plowshare Symposium on Engineering with Nuclear Explosives, Davis, Calif., Apr. 1964)	
1	18-20121	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2	18-20122	See UCRL-7711
3	18-20123	See UCRL-7738
4	18-20126	See UCRL-7770
5	18-20125	See UCRL-7762
6	18-20127	See UCRL-7773
7	18-20124	See UCRL-7761
CONF-471–	(American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963)	
1	18-21378	See MATT-251
2	18-21377	See MATT-247
CONF-472–	(American Cancer Society Conference, Rye, N. Y., May 1964)	
1	18-19505	See BNL-7912
CONF-473–	(American Institute of Chemical Engineers 56th Annual Meeting, Houston, Oct. 1963)	
1	18-20018	New York, American Inst. of Chemical Engineers, 1963, Preprint 41b, $0.50. ORINS
CONF-474–	(US/UK Libby Cockcroft Graphite Chemistry Meeting, Richland, Wash., May 1964)	
1	18-20580	See BNL-7964
CONF-475–	(Conference on Nuclear Spectroscopy and Solid State Physics, Lima, Feb. 1964)	
1	18-21121	See BNL-7958
CONF-478–	(American Ceramic Society Glass Division Meeting, Bedford, Penna., Oct. 1963)	
1	18-20616	ORINS. Gmelin, AED-CONF-63-259-1
CONF-479–	(American Physical Society Division of Plasma Physics, Colorado Springs, Colo., Nov. 1961)	
1	18-21070	ORINS. Gmelin, AED-CONF-61-126-46
CONF-480–	(Ordinary Meeting of the Institution of Mechanical Engineers, London, Nov. 1963)	
1	18-20463	ORINS
CONF-481–	(American Physical Society Annual Meeting, New York, Jan. 1964)	
1	18-21360	ORINS. Gmelin, AED-CONF-64-003-1
3	18-21162	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-225-104
4	18-21163	$1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-003-46
6	18-20729	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-003-22
7	18-20730	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-64-003-23
8	18-20812	ORINS. Gmelin, AED-CONF-64-003-26
9	18-21016	ORINS. Gmelin, AED-CONF-64-003-24
10	18-20677	ORINS. Gmelin, AED-CONF-64-003-21
11	18-21017	ORINS. Gmelin, AED-CONF-64-003-20
13	18-20706	ORINS. Gmelin, AED-CONF-64-003-18
14	18-20808	ORINS. Gmelin, AED-CONF-64-003-16
16	18-21018	ORINS. Gmelin, AED-CONF-64-003-15
17	18-21362	ORINS. Gmelin, AED-CONF-64-003-12
18	18-21361	ORINS. Gmelin, AED-CONF-64-003-11
19	18-21019	ORINS. Gmelin, AED-CONF-64-003-10
21	18-21363	ORINS. Gmelin, AED-CONF-64-003-4
23	18-21366	ORINS. Gmelin, AED-CONF-64-003-31
25	18-21020	ORINS. Gmelin, AED-CONF-64-003-38
26	18-21365	ORINS. Gmelin, AED-CONF-64-003-36
27	18-20811	ORINS. Gmelin, AED-CONF-64-003-33
28	18-20019	ORINS. Gmelin, AED-CONF-64-003-30
29	18-21355	ORINS. Gmelin, AED-CONF-64-003-29
30	18-21354	ORINS. Gmelin, AED-CONF-64-003-28
31	18-21364	ORINS. Gmelin, AED-CONF-64-003-42
34	18-21356	ORINS. Gmelin, AED-CONF-63-225-103
35	18-21358	ORINS. Gmelin, AED-CONF-64-003-45
36	18-21164	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-003-2
37	18-21133	See TID-20503
47	18-21271	Phys. Rev., 134: B499-502(1964)
CONF-482–	(Radiation Effects Conference, Syracuse, N. Y., June 1963)	
1	18-20321	ORINS. Gmelin, AED-CONF-63-222-1
CONF-483–	(Crystallography Society of Japan Annual Meeting, Tokyo, Oct. 1963)	
1	18-20809	ORINS
CONF-484–	(American Society for Quality Control 11th Western Quality Control Conference, Portland, Oreg., Apr. 1964)	
1	18-21718	See SC-R-64-135
CONF-485–	(American Society for Quality Control Portland Section Meeting, Portland, Oreg., Mar. 1964)	
1	18-21718	See SC-R-64-135
CONF-487–	(Symposium in Honor of Professor Dr. Heilmeyer's Birthday, Freiburg i. B., Mar. 1964)	
1	18-19548	See BNL-7926
CONF-489–	(5th International Symposium on the Reactivity of Solids, Munich, Aug. 1964)	
1	18-20534	See UCRL-11166
CONF-490–	(American Physical Society Fall Meeting, Gatlinburg, Tenn., Oct. 1963)	
1	18-21165	Dep.(mc); $2.60(fs), $1.07(mf) OTS
CONF-491–	(Solvent Extraction Chemistry Symposium, Gatlinburg, Tenn., Oct. 1962)	
1	18-20100	See ORNL-3524
CONF-492–	(National Association of Corrosion Engineers, Chicago, Mar. 1964)	
1	18-20470	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2	18-20471	Dep.(mc); $1.60(fs), $0.80(mf) OTS
CONF-493–	(21st Supersonic Tunnel Association Meeting, Princeton, N. J., Apr. 1964)	
1	18-21717	See SC-R-64-119
CONF-494–	(Academy of Medicine of New Jersey Symposium on Diet and Heart Disease, New Brunswick, N. J., Apr. 1964)	
1	18-21702	See BNL-7971
CONF-495–	(Golden Gate Metals Conference, San Francisco, Feb. 1964)	
1	18-20584	See SC-R-64-120
COO–		
1044-12	18-19930	Dep.(mc); $5.60(fs), $1.79(mf) OTS

Report No.	Abstract No.	Availability
1044-13	18-20038	Dep.(mc); $4.60(fs), $1.64(mf) OTS
1044-14	18-20039	Dep.(mc); $6.60(fs), $2.30(mf) OTS
1044-15	18-20040	Dep.(mc); $14.00(fs), $6.38(mf) OTS
1044-16	18-20622	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1199-3	18-20617	Dep.(mc); $2.60(fs), $1.04(mf) OTS
CRRP–	**(Canadian)**	
1183	18-21166	Dep.; $1.00(AECL)
1191	18-21167	Dep.; AECL
CVNA–	**(Misc.)**	
202	18-21630	Dep.(mc); $4.60(fs), $1.46(mf) OTS
203	18-21631	Dep.(mc); $3.60(fs), $1.34(mf) OTS
DMIC–	**(Non-AEC)**	
195	18-20452	$2.25(OTS)
DP–		
866	18-21632	Dep.; $1.25(OTS)
DPST–		
64-83-1	18-21633	Dep.(mc); $1.60(fs), $0.80(mf) OTS
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
ER–	**(Misc.)**	
5302	18-21675	See NP-13795-
5498	18-20447	See ASD-TR-7-797(IX)
EUR–	**(European Atomic Energy Community)**	
352.e	18-20168	See TID-7694
495.i	18-21373	Dep.(mc)
496.f	18-19836	Dep.(mc)
523.f	18-20281	Dep.(mc)
542.e	18-19931	Dep.(mc)
544.f	18-21370	See CEA-R-2410
581.f	18-19842	Dep.(mc)
597.e	18-21596	Dep.(mc)
599.d	18-20516	Dep.(mc)
1605.e	18-21122	Dep.(mc)
1606.e	18-21597	Dep.(mc)
1613.i	18-20517	Dep.(mc)
1622.f	18-20162	Dep.(mc)
1624.e	18-21550	Dep.(mc)
EURAEC–		
916	18-20476	Dep.(mc); $7.60(fs), $2.36(mf) OTS
952	18-20163	Dep.(mc); $4.60(fs), $0.64(mf) OTS
954	18-20459	Dep.(mc); $6.60(fs), $2.03(mf) OTS
961(Pt.2)	18-20287	Dep.(mc); $2.60(fs), $0.83(mf) OTS
965	18-20460	Dep.(mc); $6.60(fs), $2.06(mf) OTS
970	18-20488	Dep.(mc); $9.10(fs), $3.50(mf) OTS
977	18-20537	Dep.(mc); $2.60(fs), $1.04(mf) OTS
1004	18-20164	Dep.(mc); $10.50(fs), $4.40(mf) OTS
FZK–	**(Non-AEC)**	
172	18-20581	$10.10(fs), $3.86(mf) OTS
GA–	**(Misc.)**	
4169	18-21146	Nucl. Sci. Eng., 19: 108-29(1964)
4511	18-20832	$2.60(OTS)
4698	18-20874	p.257-65 of "Report of the Thermionic Conversion Specialist Conference." Schenectady, N. Y., General Electric Research Lab., 1963
4972	18-21123	
GA-Phys.–	**(Non-AEC)**	
63-11, 12	18-20833	$11.50(OTS)
GAT-R–		
335	18-20230	Dep.(mc); $5.60(fs), $1.73(mf) OTS
GEAP–	**(Misc.)**	
3971	18-21634	Dep.; $4.50(OTS)
4481	18-21635	Dep.(mc); $7.60(fs), $2.54(mf) OTS
4483	18-21563	Dep.(mc); $3.60(fs), $1.34(mf) OTS
GEMP–	**(Misc.)**	
81	18-21564	Dep.; $0.75(OTS)
223	18-21168	Dep.(mc); $3.60(fs), $1.13(mf) OTS
274	18-21668	Dep.(mc); $9.10(fs), $3.44(mf) OTS
278	18-21169	Dep.(mc); $3.60(fs), $1.28(mf) OTS
279	18-21170	Dep.(mc); $1.10(fs), $0.80(mf) OTS
283	18-21551	Dep.(mc); $9.10(fs), $3.35(mf) OTS
GNE-Phys.–	**(Non-AEC)**	
63-2	18-21374	$10.50(OTS)
HW–		
71793	18-20429	Dep.(mc); $1.60(fs), $0.80(mf) OTS
72415	18-20453	$2.60(fs), $0.83(mf) OTS
72844	18-21636	Dep.(mc); $1.10(fs), $0.80(mf) OTS
73381(Suppl.1)	18-21545	Dep.; $2.25(OTS)
74949	18-20518	Dep.; $0.50(OTS)
77163	18-21691	Dep.(mc); $8.60(fs), $3.14(mf) OTS
79960	18-21613	Dep.(mc); $1.10(fs), $0.80(mf) OTS
80680	18-21681	Dep.(mc); $1.60(fs), $0.80(mf) OTS
HW-SA–		
3028	18-21704	Dep.(mc); $2.60(fs), $0.89(mf) OTS
3035	18-20282	Dep.(mc); $4.60(fs), $1.67(mf) OTS
3048	18-20231	Dep.(mc); $2.60(fs), $0.89(mf) OTS
3244	18-19875	Anal. Chem., 36: 1104-6(1964)
3291	18-19539	Nature, 201: 104-6(1964)
IA–	**(Non-AEC)**	
800	18-21124	Dep.(mc)
899	18-21598	Dep.(mc)
IDO–		
16812	18-21565	Dep.; $2.00(OTS)
16871-2	18-21682	Dep.; $2.75(OTS)
16908	18-21685	Nucl. Sci. Eng., 19: 39-47(1964)
IITRI–	**(Misc.)**	
1184-12	18-21705	Dep.(mc); $3.60(fs), $1.13(mf) OTS
INSJ–	**(Japanese)**	
67	18-20226	Dep.(mc)
68	18-21171	Dep.(mc)
IS–		
551	18-20519	Dep.(mc); $2.60(fs), $0.89(mf) OTS
616	18-20552	Phys. Chem. Solids, 25: 389-94(1964)
655	18-19519	Dep.(mc); $1.10(fs), $0.80(mf) OTS
658	18-19843	Dep.(mc); $1.60(fs), $0.80(mf) OTS
773	18-19879	Anal. Chem., 36: 1166-7(1964)
780	18-20098	Dep.; $2.75(OTS)
814	18-20104	Anal. Chem., 36: 1095-7(1964)
841	18-20520	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ISPRA–	**(Italian)**	
455	18-19844	Dep.(mc)
JAERI–	**(Japanese)**	
1053	18-19845	Dep.(mc)
1057	18-20232	Dep.(mc)
JINR–	**(Russian)**	
E-1557	18-20902	Dep.(mc)
E-1561	18-21172	Dep.(mc)

Report No.	Abstract No.	Availability
E-1581	18-20903	Dep.(mc)
P-1479	18-21173	Dep.(mc)
P-1553	18-20904	Dep.(mc)
P-1559	18-20905	Dep.(mc)
P-1562	18-20906	Dep.(mc)
P-1563	18-21177	Dep.(mc)
P-1564	18-20907	Dep.(mc)
P-1565	18-20623	Dep.(mc)
P-1566	18-20908	Dep.(mc)
P-1568	18-21178	Dep.(mc)
P-1572	18-20909	Dep.(mc)
P-1573	18-21179	Dep.(mc)
P-1574	18-21180	Dep.(mc)
P-1575	18-21181	Dep.(mc)
P-1579	18-21182	Dep.(mc)
P-1580	18-21183	Dep.(mc)
P-1583	18-21184	Dep.(mc)
JPRS–	**(Non-AEC)**	
23956	18-19508	$0.75(OTS)
24139	18-20238	$0.50(OTS)
24187	18-19558	$0.50(OTS)
KAPL–		
3016	18-20521	Dep.; $1.00(OTS)
KR–	**(Norwegian)**	
64	18-21185	Dep.(mc)
66	18-21706	Dep.(mc)
KY–		
453	18-19932	Dep.; $1.00(OTS)
LA–		
1493	18-21203	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3029	18-20099	Dep.; $0.75(OTS)
3058	18-19846	Dep.; $0.50(OTS)
LADC–		
4730	18-21296	Phys. Rev., 134: B796-816(1964)
5249	18-21411	Phys. Fluids, 7: 735-53(1964)
5561	18-20454	Dep.(mc); $10.50(fs), $4.34(mf) OTS
5645	18-21263	Nucl. Phys., 52: 505-14(1964)
5788	18-20522	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5814	18-20624	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5817	18-20130	Dep.(mc); $1.10(fs), $0.80(mf) OTS
6109	18-20648	Phys. Fluids, 7: 684-96(1964)
6302	18-21204	Dep.(mc); $3.60(fs), $1.16(mf) OTS
LAMS–		
2378(Vol.II)	18-19847	Dep.; $5.50(OTS)
MATT–		
236	18-21375	Dep.(mc); $1.60(fs), $0.80(mf) OTS
238	18-21376	Dep.; $2.75(OTS)
247	18-21377	Dep.(mc); $1.60(fs), $0.80(mf) OTS
251	18-21378	Dep.(mc); $1.60(fs), $0.80(mf) OTS
MIT–	**(Misc.)**	
905-1	18-19837	Dep.(mc); $10.50(fs), $4.34(mf) OTS
MLM-		
1177	18-21707	Dep.; $2.60(fs), $1.01(mf) OTS
1178	18-21708	Dep.; $2.60(fs), $0.92(mf) OTS
1179	18-21709	Dep.; $3.60(fs), $1.37(mf) OTS
MMPP–	**(Misc.)**	
167-6	18-20041	Dep.(mc); $3.60(fs), $1.25(mf) OTS
MTA–		
15	18-20486	Dep.(mc); $8.10(fs), $2.87(mf) OTS

Report No.	Abstract No.	Availability
N–	**(Misc.)**	
63-13602	18-21379	$1.60(fs), $0.80(mf) OTS
63-20620	18-20443	See AD-416199
63-21469	18-20625	
63-23039	18-21380	See NASA-TM-X-50732
63-23807	18-20581	See FZK-172
NAA-SR–		
9190	18-21669	Dep.; $2.25(OTS)
NAA-SR-Memo–		
2368(Rev.)	18-20131	Dep.(mc); $2.60(fs), $1.01(mf) OTS
7485	18-21567	Dep.(mc); $3.60(fs), $1.31(mf) OTS
7545	18-21552	Dep.(mc); $4.60(fs), $1.55(mf) OTS
7771	18-21553	Dep.(mc); $2.60(fs), $0.98(mf) OTS
8017	18-21614	Dep.(mc); $7.60(fs), $2.57(mf) OTS
8061	18-21554	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8073	18-20283	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8079	18-21568	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8121	18-21569	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8123	18-20165	Dep.(mc); $2.60(fs), $0.92(mf) OTS
8214	18-21637	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8217	18-21570	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8266	18-21638	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8289	18-20132	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8435	18-20284	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9003	18-21571	Dep.(mc); $3.60(fs), $1.13(mf) OTS
9117	18-21670	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9164	18-21615	Dep.(mc); $3.60(fs), $1.37(mf) OTS
9232	18-21671	Dep.(mc); $3.60(fs), $1.28(mf) OTS
9241	18-21639	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9253	18-21572	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9340	18-20472	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9382	18-21599	Dep.(mc); $5.60(fs), $1.79(mf) OTS
9391	18-21640	Dep.(mc); $6.60(fs), $2.09(mf) OTS
9406	18-20455	Dep.(mc); $2.60(fs), $0.98(mf) OTS
9429	18-21555	Dep.(mc); $3.60(fs), $1.28(mf) OTS
9431	18-21556	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9444	18-21557	Dep.(mc); $12.50(fs), $5.39(mf) OTS
9489	18-21600	Dep.(mc); $2.60(fs), $1.10(mf) OTS
9507	18-21672	Dep.(mc); $3.60(fs), $1.25(mf) OTS
9569	18-21616	Dep.(mc); $1.10(fs), $0.80(mf) OTS
9576	18-21673	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9638	18-21710	Dep.(mc); $1.60(fs), $0.80(mf) OTS
9683	18-20439	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NASA-CR–	**(Non-AEC)**	
52319	18-20581	See FZK-172
54008	18-20473	
54017	18-19926	See BATT-4673-FINAL
NASA-TM–	**(Non-AEC)**	
X-50732	18-21380	$2.60(fs), $0.83(mf) OTS
NASA-TN–	**(Misc.)**	
D-2071	18-21381	$2.75(OTS)
D-2157	18-21674	$1.50(OTS)
D-2273	18-21382	$0.75(OTS)
NAVDOCKS-P–	**(Non-AEC)**	
310	18-20197	GPO
NBS–	**(Misc.)**	
8239	18-21095	Dep.(mc); $10.10(fs), $4.07(mf) OTS
NIRL-R–	**(British)**	
49	18-20680	Dep.(mc); $1.10(BIS); 5s. 6d. (HMSO)
58	18-20582	Dep.(mc); $0.70(BIS); 3s. 6d. (HMSO)
NP–	**(AEC File No. for Non-AEC Reports)**	
13793	18-21641	Dep.(mc); $6.60(fs), $2.03(mf) OTS

Report No.	Abstract No.	Availability
13795	18-21675	
13796	18-19515	
13799	18-20618	
13800	18-20626	
13805	18-21546	
13806	18-20233	
13807	18-21205	
13808	18-20834	
13809	18-21096	
13810	18-20166	
13811	18-20523	
13812	18-20167	
13813	18-21206	
13814	18-20835	
13815	18-20627	
13837	18-20910	Dep.(mc)
13839	18-21207	Dep.(mc)
13840	18-20335	Dep.(mc)
13841	18-21208	Dep.(mc)
13842	18-21209	Dep.(mc)
13844	18-20628	Dep.(mc)
13846	18-20212	Dep.(mc)
13850	18-20629	Dep.(mc)
13851	18-20336	Dep.(mc)
13852	18-21383	Dep.(mc)
13853	18-21384	Dep.(mc)
13856	18-19815	$0.40(GPO)
13857	18-19549	$0.25(GPO)
13859	18-20234	Dep.(mc)
13862	18-19933	
13863	18-21385	
13867	18-20201	
13868	18-20235	Dep.
13873	18-20911	Dep.(mc)
13874	18-19934	
13878	18-21023	Dep.(mc)
NP-tr-	**(AEC File No. for Non-AEC Translations)**	
1124	18-20239	Dep.(mc); $1.10(fs), $0.80(mf) JCL
NR-	**(Misc.)**	
342-022	18-20892	See AD-434059
NRC-	**(Canadian)**	
7798	18-21071	Can. J. Phys., 42: 616-26(1964)
7876	18-21226	Can. J. Phys., 42: 833(1964)
NRL-	**(Misc.)**	
F11	18-20234	See NP-13859
NYO-		
2181-1	18-19550	Dep.; $3.50(OTS)
2553-1	18-20337	$2.60(fs), $1.07(mf) OTS
2762	18-19551	Dep.; $1.00(OTS)
2769-1	18-19552	$1.60(fs), $0.80(mf) OTS
3140-1B	18-21711	Dep.(mc); $7.60(fs), $2.48(mf) OTS
3250-1	18-21642	Dep.(mc); $19.75(fs), $10.31(mf) OTS
9802	18-20133	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10065	18-21712	Dep.(mc); $10.10(fs), $3.89(mf) OTS
10434	18-21386	Dep.(mc); $9.10(fs), $3.41(mf) OTS
10435	18-21387	Dep.(mc); $7.60(fs), $2.51(mf) OTS
10436	18-20630	Dep.(mc); $6.60(fs), $2.18(mf) OTS
10437	18-21713	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10475	18-21573	Dep.(mc); $9.10(fs), $3.35(mf) OTS
ORA-	**(Misc.)**	
3710-3-P	18-20041	See MMPP-167-6
03712-6-T	18-20633	See TID-20512
05750-6-P	18-20160	See AD-423679
05750-9-P	18-20166	See NP-13810
ORNL-		
3300(Vol.3)	18-21714	Dep.; $4.00(OTS)
3524	18-20100	Dep.; $1.00(OTS)
3593	18-20456	Dep.; $1.00(OTS)
3608	18-20524	Dep.; $0.50(OTS)
ORNL-TM-		
791	18-21715	Dep.(mc); $7.60(fs), $2.48(mf) OTS
792	18-20134	Dep.(mc); $5.60(fs), $1.91(mf) OTS
794	18-21716	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ORNL-tr-		
19	18-21733	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
42	18-21734	Dep.(mc); $1.10(fs), $0.80(mf) JCL or OTS
ORO-		
591	18-19848	Dep.; $0.50(OTS)
OTS-	**(Misc.)**	
64-21950	18-19508	See JPRS-23956
64-31050	18-20238	See JPRS-24139
64-31076	18-19558	See JPRS-24187
PAN-	**(Polish)**	
279	18-21131	Dep.
288	18-21210	Dep.
299	18-21211	Dep.
445/VI	18-21212	Dep.
465/VIII	18-20110	J. Chromatog., 14: 79-96(1964)
468/VII	18-20912	Dep.
469/I	18-20338	Dep.
473/II	18-20583	Dep.
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
954,407	18-21582	
954,474	18-21690	
954,542	18-21662	
954,593	18-21547	
954,594	18-21548	
954,630	18-21663	
954,655	18-20506	
954,718	18-21664	
954,720	18-20507	
954,776	18-21621	
954,777	18-21622	
954,798	18-21583	
954,821	18-20508	
954,868	18-20509	
954,928	18-20889	
954,939	18-20465	
954,954	18-20199	
955,122	18-20322	
955,138	18-20466	
955,268	18-21542	
955,336	18-21623	
955,345	18-21584	
955,381	18-20159	
955,394	18-20436	
955,425	18-21624	
955,426	18-21625	
955,462	18-20510	
955,485	18-21626	
955,526	18-21585	
955,607	18-21586	
955,629	18-20511	
955,669	18-21587	
955,708	18-20467	
PATENTS	**(U. S.)**	
3,130,010	18-20117	
3,130,042	18-20118	

Report No.	Abstract No.	Availability
3,130,128	18-21588	
3,130,129	18-21589	
3,130,130	18-21590	
3,130,303	18-20323	
3,130,311	18-20324	
3,130,314	18-20427	
3,130,330	18-20890	
3,131,129	18-21627	
3,131,138	18-20096	
3,131,239	18-20437	
3,131,299	18-21022	
3,131,300	18-20709	
3,131,305	18-20417	
PG-Report-	**(British)**	
565	18-20236	Dep.
583	18-19849	Dep.; $0.20(BIS); 1s. 2d. (HMSO)
PUC-		
1963-106	18-20688	Nucl. Instr. Methods, 26: 51-4(1964)
1963-118	18-21275	Phys. Rev., 134: B515-38(1964)
1963-120	18-21291	Phys. Rev., 134: B752-64(1964)
1964-138	18-21299	Phys. Rev. Letters, 12: 420-3(1964)
Q-	**(Misc.)**	
A2392-3-11	18-20135	See TID-20448
R-	**(Misc.)**	
61SD066	18-20836	
63SD89	18-20525	$3.60(OTS)
RADC-TDR-	**(Misc.)**	
63-269	18-20526	$9.60(OTS)
RFP-		
351	18-20527	Dep.(mc); $1.10(fs), $0.80(mf) OTS
RM-	**(Misc.)**	
3803-AEC	18-20731	Dep.(mc); $5.60(fs), $1.73(mf) OTS
RPI-	**(Misc.)**	
328-4	18-21132	$1.10(fs), $0.80(mf) OTS
RR-TN-	**(Non-AEC)**	
63-2	18-20625	See N63-21469
RRL-		
120	18-20058	J. Am. Chem. Soc., 86: 1483-8(1964)
RT-CHI-	**(Italian)**	
(63)33	18-19944	Atti. Accad. Nazl. Lincei, Rend., Classe Sci. Fis., Mat. Nat. (8), 33: 472-6(1962)
RT-PROT-	**(Italian)**	
(63)12	18-21696	Rend. Acad. Sci. Fis. Mat., Soc. Nazl. Sci. Napoli, (4), 29: 259-84(1962)
RTI-		
2513-T12	18-19848	See ORO-591
SC-DC-		
64-383	18-20195	Dep.(mc); $1.10(fs), $0.80(mf) OTS
64-420	18-20631	Dep.(mc); $10.10(fs), $4.01(mf) OTS
SC-R-		
64-119	18-21717	Dep.(mc); $1.10(fs), $0.80(mf) OTS
64-120	18-20584	Dep.(mc); $1.60(fs), $0.80(mf) OTS
64-135	18-21718	Dep.(mc); $1.60(fs), $0.80(mf) OTS
748	18-21719	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SC-T-		
64-49	18-19854	Dep.(mc); $1.10(fs), $0.80(mf) JCL
64-610	18-21735	Dep.(mc); $2.60(fs), $0.95(mf) JCL
64-613	18-19940	Dep.(mc); $1.10(fs), $0.80(mf) JCL
64-615	18-21736	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SC-TM-		
264-63(15)	18-21720	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCL-DR-		
64-13	18-20285	Dep.(mc); $2.60(fs), $0.92(mf) OTS
SM-		
51/50	18-19814	See CONF-453-1
SSD-TDR-	**(Non-AEC)**	
63-217	18-21676	$5.60(OTS)
STI-PUB-	**(International Atomic Energy Agency)**	
78(Vol.II)	18-20267	$11.00; Sch 231.-; 66s.stg; F.fr.44.-; DM 38.50 (IAEA)
SWRI-		
1228-18	18-20528	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1228-19	18-20457	Dep.(mc); $1.60(fs), $0.80(mf) OTS
TDR-	**(Non-AEC)**	
169(3560-20) TN-1	18-21676	See SSD-TDR-63-217
TID-		
7694	18-20168	Dep.(mc); $11.00(fs), $4.67(mf) OTS
12794	18-20474	Dep.(mc); $3.60(fs), $1.13(mf) OTS
18689	18-20632	Dep.(mc); $2.60(fs), $0.83(mf) OTS
18753	18-21721	Dep.(mc); $3.60(fs), $1.22(mf) OTS
18810	18-21722	Dep.(mc); $2.60(fs), $0.92(mf) OTS
18814	18-19935	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18835	18-20183	Dep.(mc); $1.60(fs), $0.80(mf) OTS
18877	18-21723	Dep.(mc); $3.60(fs), $1.13(mf) OTS
18939	18-20586	Appl. Optics, 3: 647-8(1964)
19148	18-21139	J. Chem. Educ., 41: 156-8(1964)
19684	18-21259	Nucl. Phys., 52: 457-64(1964)
19856	18-21044	Phys. Rev., 134: B687-97(1964)
19915	18-21286	Phys. Rev., 134: B718-21(1964)
20265	18-20657	Rev. Mod. Phys., 36: 669-79(1964)
20401	18-19506	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20402	18-19507	$2.60(fs), $0.83(mf) OTS
20404	18-21724	$3.60(fs), $1.19(mf) OTS
20437	18-21725	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20440	18-21213	Dep.(mc); $2.60(fs), $1.01(mf) OTS
20448	18-20135	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20457	18-20681	Dep.(mc); $3.60(fs), $1.22(mf) OTS
20462	18-20960	Phys. Rev. Letters, 12: 485-7(1964)
20463	18-20529	Dep.(mc); $8.10(fs), $2.90(mf) OTS
20472	18-19850	Dep.(mc); $10.10(fs), $3.98(mf) OTS
20483	18-20913	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20485	18-19936	Dep.(mc); $2.60(fs), $0.89(mf) OTS
20487	18-21726	Dep.; $3.60(fs), $1.34(mf) OTS
20488	18-20914	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20489	18-21727	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20490	18-20915	Dep.(mc); $3.60(fs), $1.19(mf) OTS
20491	18-21388	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20499	18-19520	Dep.(mc); $6.60(fs), $2.03(mf) OTS
20503	18-21133	Dep.(mc); $2.60(fs), $1.07(mf) OTS
20504	18-20339	Dep.(mc); $9.10(fs), $3.44(mf) OTS
20509	18-21389	Dep.(mc); $2.60(fs), $0.98(mf) OTS
20510	18-20023	Dep.(mc); $8.60(fs), $3.14(mf) OTS
20511	18-20619	Dep.(mc); $14.50(fs), $6.53(mf) OTS
20512	18-20633	Dep.(mc); $12.50(fs), $5.42(mf) OTS
20513	18-19553	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20514	18-19937	Dep.(mc); $8.10(fs), $2.87(mf) OTS
20525	18-20340	Dep.(mc); $2.60(fs), $0.89(mf) OTS

Report No.	Abstract No.	Availability
20540	18-21134	Dep.; $1.60(fs), $0.80(mf) OTS
20548	18-19851	Dep.(mc); $1.10(fs), $0.80(mf) OTS
20550	18-19554	Dep.(mc); $8.10(fs), $2.69(mf) OTS
20552	18-21677	Dep.(mc); $2.60(fs), $1.07(mf) OTS
20563	18-20682	Dep.(mc); $1.60(fs), $0.80(mf) OTS
20564	18-20341	Dep.(mc); $8.10(fs), $2.90(mf) OTS
TM–	**(Misc.)**	
3388-67	18-21677	See TID-20552
3866-67	18-20523	See NP-13811
TRG-Report–	**(British)**	
532	18-20579	See AAEC/E-115
UCRL–		
6894(Rev.II)	18-20530	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6911(Rev.1)	18-20359	Nucl. Instr. Methods, 26: 1-6(1964)
7006-T	18-21135	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7177	18-20634	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7205-T	18-20635	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7230(Rev.I)	18-21269	Phys. Rev., 134: B481-4(1964)
7255	18-20531	Dep.(mc); $4.60(fs), $1.67(mf) OTS
7286-T(Pt.2)	18-20636	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7290-T	18-20637	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7307-T	18-21728	Dep.(mc); $2.60(fs), $1.04(mf) OTS
7308-T	18-21097	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7326	18-20196	Dep.(mc); $2.60(fs), $1.07(mf) OTS
7327	18-20286	Dep.(mc); $3.60(fs), $1.40(mf) OTS; Gmelin, AED-CONF-63-124-11
7330	18-21390	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7347	18-20638	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7349	18-21729	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7381-T	18-20532	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7395-T	18-21741	See CONF-201-3
7480	18-20553	Phys. Chem. Solids, 25: 423-9(1964)
7707	18-21414	Phys. Fluids, 7: 764-6(1964)
7711	18-20122	Dep.(mc); $2.60(fs), $1.10(mf) OTS
7738	18-20123	Dep.(mc); $3.60(fs), $1.31(mf) OTS
7761	18-20124	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7762	18-20125	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7770	18-20126	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7773	18-20127	Dep.(mc); $3.60(fs), $1.40(mf) OTS
10446	18-21730	Dep.(mc); $2.60(fs), $0.89(mf) OTS
10630(Rev.)	18-21214	Dep.(mc); $3.60(fs), $1.13(mf) OTS
10698(Rev.)	18-21412	Phys. Fluids, 7: 754-9(1964)
10727(Rev.)	18-21260	Nucl. Phys., 52: 465-80(1964)
10728	18-20533	Dep.(mc); $3.60(fs), $1.13(mf) OTS
10745	18-20369	Nucl. Instr. Methods, 26: 132-6(1964)
10773	18-20916	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10781	18-20342	Dep.(mc); $2.60(fs), $0.92(mf) OTS
10786	18-20917	Dep.(mc); $1.10(fs), $0.80(mf) OTS
10797	18-20918	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10823(Rev.)	18-20026	J. Chem. Phys., 40: 2114-22(1964)
10880	18-21274	Phys. Rev., 134: B509-14(1964)
10982	18-21253	Nucl. Phys., 52: 381-4(1964)
11123	18-21330	Z. Physik, 178: 335-41(1964)
11144	18-21051	Phys. Rev., 134: B919(1964)
11147	18-20343	Dep.(mc); $2.60(fs), $0.83(mf) OTS
11152	18-21042	Phys. Rev., 134: B630-2(1964)
11164	18-20936	Phys. Rev., 134: B633-5(1964)
11166	18-20534	Dep.(mc); $2.60(fs), $0.98(mf) OTS
11252	18-19938	Dep.; $0.75(OTS)
11261	18-20344	Dep.(mc); $1.10(fs), $0.80(mf) OTS
11300	18-20101	Dep.; $0.50(OTS)
UCRL-Trans–		
1011(L)	18-19855	Dep.(mc); $1.10(fs), $0.80(mf) JCL
1040(L)	18-21737	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
1045	18-21738	Dep.(mc); $1.10(fs), $0.80(mf) JCL
1050(L)	18-20734	Dep.(mc); $1.60(fs), $0.80(mf) JCL
UJV–	**(Czechoslovakian)**	
850/63	18-20102	Dep.(mc)
909/63	18-19838	Dep.(mc)
992/63	18-19852	Dep.(mc)
1002-63	18-21215	Dep.(mc)
USNRDL-TR–	**(Non-AEC)**	
700	18-20237	OTS
716	18-19521	$3.60(OTS)
717	18-20458	$2.60(OTS)
718	18-20042	$3.60(OTS)
721	18-19555	$3.60(OTS)
VDDIT–	**(Swedish)**	
87	18-20475	Dep.(mc)
WADD-TR–	**(Non-AEC)**	
60-782(Pt.XXI)	18-19939	$1.00(OTS)
WANL-PR–	**(Misc.)**	
(N)-002	18-20487	Dep.(mc); $3.60(fs), $1.22(mf) OTS
WANL-TNR–	**(Misc.)**	
109	18-20585	
WAPD-MRP–		
107	18-21643	Dep.; $2.50(OTS)
WAPD-T–		
1576(Rev.)	18-20440	Dep.(mc); $1.60(fs), $0.80(mf) OTS
WIS-TCI–	**(Misc.)**	
41	18-20733	Dep.(mc); $1.60(fs), $0.80(mf) OTS
XDC–		
61-4-54	18-20474	See TID-12794
Y–		
8	18-21213	See TID-20440
10	18-20681	See TID-20457
1455	18-20535	Dep.; $2.00(OTS)
1461	18-21731	Dep.; $1.50(OTS)

UNITED STATES ATOMIC ENERGY COMMISSION

NUCLEAR SCIENCE ABSTRACTS

Volume 18

Numbers 1-6

Abstracts 1-9802

January-March

1964

Division of Technical Information

Managing Editor

John W. Norris

Assistant Managing Editor

Donald D. Davis

Associate Editor

Robert C. Kelly

Production Editor

Lawrence T. Whitehead

Technical Editor

David E. Bost

Subject Index Editor

Everett J. Hoffman

Evaluators

William D. Matheny
John H. Mitchell
Mary H. Newman
Lee M. Thompson

Subject Authority Editor

Thomas R. Henley

Corporate Authority Editor

Clara L. Fox

Abstractors

D. Lamar Cason
James R. Dulaney
Helen M. Gant
Bernard O. Griggs
Mary Catherine Grissom
Miriam P. Guthrie
Phyllis Hansen
Thomas F. Heagerty
Carolyn D. Houston
Rose V. Jermain
Julia Redford
Ned W. Rizzardi
Lila B. Smith
Charles E. Stuber
Martha J. Thomas
Robert E. Upchurch
Anne G. Ward
David C. West

Exchanges

Margaret L. Pflueger

Report Code Authority

Hannah B. Mayfield

Report Number Index Editor

Bobbie J. Dunlap

Scheduling and Publishing Coordinator

Henry H. Lansford

Communication concerning the editorial policy and content of *NSA* should be addressed to the Managing Editor, *Nuclear Science Abstracts*, AEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

UNITED STATES ATOMIC ENERGY COMMISSION

NUCLEAR SCIENCE ABSTRACTS

Volume 18

Numbers 7-12

Abstracts 9803-21741

April-June

1964

Division of Technical Information

Managing Editor

John W. Norris

Assistant Managing Editor

Donald D. Davis

Associate Editor

Robert C. Kelly

Production Editor

Lawrence T. Whitehead

Technical Editor

David E. Bost

Subject Index Editor

Everett J. Hoffman

Evaluators

William D. Matheny
John H. Mitchell
Mary H. Newman
Lee M. Thompson

Subject Authority Editor

Thomas R. Henley

Corporate Authority Editor

Clara L. Fox

Abstractors

D. Lamar Cason
James R. Dulaney
Helen M. Gant
Bernard O. Griggs
Mary Catherine Grissom
Miriam P. Guthrie
Phyllis Hansen
Thomas F. Heagerty
Carolyn D. Houston
Rose V. Jermain
Julia Redford
Ned W. Rizzardi
Lila B. Smith
Charles E. Stuber
Martha J. Thomas
Robert E. Upchurch
Anne G. Ward
David C. West

Exchanges

Margaret L. Pflueger

Report Code Authority

Hannah B. Mayfield

Report Number Index Editor

Bobbie J. Dunlap

Scheduling and Publishing Coordinator

Henry H. Lansford

Communication concerning the editorial policy and content of *NSA* should be addressed to the Managing Editor, *Nuclear Science Abstracts*, AEC Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

Volume 18, 1964

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director.
Published by the USAEC Division of Technical Information Extension, Robert L. Shannon, Extension Manager.

Nuclear Science Abstracts covers the international literature on nuclear science and technology and provides the only comprehensive abstracting and indexing of this body of information. Published twice each month since 1947, *NSA* covers technical reports of the U. S. Atomic Energy Commission and its contractors, technical reports of U. S. Government agencies and other governments, universities, industrial and research organizations, as well as patents, books, and journal literature on a world-wide basis. More than 250,000 abstracts have appeared in *NSA* through Volume 17. The subject matter covered in *NSA* is described in detail in Report TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Abstracts are arranged according to a number of subject categories and subcategories. Definitions of categories appear in Issues No. 1 and 13. If the language of the original item is not English, the language will be indicated. Translations are not abstracted where an abstract of the original item has appeared in *NSA*.

INDEXES TO NSA

Subject, personal author, corporate author, and report number indexes appear in each issue and are cumulated quarterly, semiannually, and annually. The cumulative report number index annually cumulates all report numbers in all volumes.

AVAILABILITY OF PUBLICATIONS ABSTRACTED

The public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations taken from *Dissertation Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan.

Most of the published literature abstracted in *NSA* is on deposit at the Oak Ridge Institute of Nuclear Studies Library, Oak Ridge, Tennessee, (a USAEC depository library) and is available through interlibrary loan. When requesting papers from this source, it is important that *NSA* volume and abstract number be cited.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

NSA is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Inquiries should be directed to the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.

Government agencies may obtain *NSA* free of charge.

NSA is available to the general public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., as follows:

For the 24 regular issues, $30.00 domestic, $37.00 foreign. A single issue costs $1.75, plus 25 per cent for foreign mailing. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, British and French Guiana, Surinam, and British Honduras. Foreign rates apply to the countries excepted above and to all other countries throughout the world.

For the quarterly, semiannual, and annual indexes, $22.00 domestic, $25.00 foreign.

Multivolume subject and author indexes are available as follows:

Vols. 1–4 (1948–1950) Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003, $30.00.

Vols. 5–10 (1951–1956) Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $5.25.

Vols. 11–15, Subjects, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $19.00.

Vols. 11–15, Personal Authors, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $14.25.

Vols. 11–15, Corporate Authors, Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402, $2.50.

Annual Indexes are available separately from the U. S. Government Printing Office as follows:

Vol. 16, Subject and Authors, $9.75.

Vol. 17, Subject and Authors, $12.25.

Cumulative Report Number, $5.25.

ACKNOWLEDGMENTS

Agreements between the United States Atomic Energy Commission and the following organizations with regard to providing continuing services and specific literature coverage for *Nuclear Science Abstracts* are gratefully acknowledged:

American Institute of Physics; Atomic Energy of Canada Limited; Atomic Energy Research Establishment, United Kingdom; European Atomic Energy Community (EURATOM); Gmelin Institute; International Atomic Energy Agency; Japan Atomic Energy Bureau—Japan Atomic Energy Research Institute; Netherlands Patent Office; Reactor Centrum Nederland.

DEPOSITORIES OF USAEC REPORTS

In Countries Other than the U.S.

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, Australian National Library
Sutherland, New South Wales, Australian Atomic Energy Commission

AUSTRIA
Vienna, Zentral Bibliothek der Physikalischen Institute der Universität

BELGIUM
Mol-Donk, Centre d'Etude de l'Energie Nucleaire

BOLIVIA
La Paz, Comisión Nacional de Energiá Nuclear

BRAZIL
Rio de Janeiro, Instituto Brasileiro de Bibliografia e Documentacao
São Paulo, Instituto de Energia Atomica, Cidade Universitaria São Paulo

BURMA
Rangoon, Union of Burma Applied Research Institute, Atomic Energy Center Library

CANADA
Hamilton, McMaster University
Ottawa, National Research Council Library
Vancouver, University of British Columbia

CEYLON
Colombo, University of Ceylon

CHILE
Santiago, Instituto de Fisica y Matematicas, Universidad de Chile

CHINA
Hsinchu, Taiwan, Free China, National Tsing Hua University

COLOMBIA
Bogota, Instituto De Asuntos Nucleares

COSTA RICA
San Pedro, University of Costa Rica Library

DENMARK
Risö, Danish Atomic Energy Commission

DOMINICAN REPUBLIC
Santo Domingo, Comisión Nacional de Asuntos Nucleares

ECUADOR
Quito, Escuela Politécnica Nacional

EGYPT
Cairo, Atomic Energy Commission

EL SALVADOR
San Salvador, Universidad de El Salvador, Biblioteca de Energia Nuclear

ENGLAND
Birmingham, Central Library
Bristol, Central Library
Kingston upon Hull, Central Library
Leeds, Central Library
Liverpool, Central Library
London, Central Library, Acton
London, Science Museum Library, South Kensington
Manchester, Central Library

ENGLAND (CONT.)
Newcastle upon Tyne, Central Library
Nottingham, Central Library
Sheffield, Central Library

FINLAND
Helsinki, Teknillisen Korkeakoulun Kirjasto

FRANCE
Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay
Paris, Académie des Sciences

GERMANY
Berlin, Hahn-Meitner-Institut für Kernforschung Berlin
Frankfurt/Main, Gmelin-Institut
Munich, Technische Hochschule, Bibliothek

GHANA
Accra, University College of Ghana

GREECE
Athens, Nuclear Research Center "Democritus"

GUATEMALA
Guatemala, Comisión Nacional de Energía Nuclear

HAITI
Port au Prince, University of Haiti

HONDURAS
Tegucigalpa, Comisión Hondureña de Energía Atómica

ICELAND
Reykjavik, University of Iceland, Atomic Energy Library

INDIA
Bombay, Department of Atomic Energy

INDONESIA
Bandung, Java, Bandung Institute of Technology
Djogjakarta, Java, Science Faculty, Gadjah Mada University

IRAN
Tehran, Tehran University Center for Nuclear Studies

IRAQ
Baghdad, Iraqi Atomic Energy Commission

IRELAND
Dublin, University College

ISRAEL
Rehovoth, Israel Atomic Energy Commission

ITALY
Rome, Centro di Studi Nucleari della Casaccia
Rome, Comitato Nazionale per l'Energia Nucleare

JAPAN
Tokyo, National Diet Library

KOREA
Seoul, Office of Atomic Energy

LEBANON
Beirut, Lebanese National Council for Scientific Research

LUXEMBOURG
Luxembourg, Ministry of Transport and Electricity

MALAYA
Kuala Lumpur, University of Malaya

MEXICO
Mexico, D.F., Comisión Nacional de Energía Nuclear

NETHERLANDS
The Hague, Reactor Centrum Nederland

NEW ZEALAND
Wellington, Department of Scientific and Industrial Research

NIGERIA
Ibadan, University of Ibadan

NORTHERN IRELAND
Belfast, City Library

NORWAY
Lillestrom, Institutt för Atomenergi

PAKISTAN
Lahore, West Pakistan, Atomic Energy Centre

PERU
Lima, Junta de Control de Energia Atomica

PHILIPPINE REPUBLIC
Manila, Philippine Atomic Energy Commission

POLAND
Warsaw, Biura Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej

PORTUGAL
Sacavem, Junta de Energía Nuclear

REPUBLIC OF SOUTH AFRICA
Pretoria, Atomic Energy Board Library

REPUBLIC OF THE CONGO
Leopoldville, Université Lovanium

SCOTLAND
Glasgow, Mitchell Library

SPAIN
Madrid, Junta de Energía Nuclear, Biblioteca Documentación y Publicaciones, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi

SWITZERLAND
Zurich, Institut für Physik, Eidg. Technische Hochschule

THAILAND
Bangkok, Office of the Thai Atomic Energy Commission, Department of Science

TURKEY
Ankara, Turkish Atomic Energy Commission, Atomic Energy Library

URUGUAY
Montevideo, Comision Nacional de Energia Atomica

VENEZUELA
Caracas, Instituto Venezolano de Investigaciones Científicas

VIET-NAM
Dalat, Institute of Nuclear Research, Atomic Energy Office

YUGOSLAVIA
Belgrade, Federal Commission for Nuclear Energy

In International Agencies

AUSTRIA
Vienna, International Atomic Energy Agency

BELGIUM
Brussels, La Bibliotheque EURATOM

FRANCE
Paris, European Nuclear Energy Agency, O.E.C.D.

ITALY
Ispra, EURATOM Research Center

SWITZERLAND
Geneva, United Nations Library

UNITED STATES
Washington, D. C., Inter-American Nuclear Energy Commission

UNITED STATES
GOVERNMENT PRINTING OFFICE
DIVISION OF PUBLIC DOCUMENTS
WASHINGTON, D.C. 20402

OFFICIAL BUSINESS

PENALTY FOR PRIVATE USE TO AVOID
PAYMENT OF POSTAGE, $300